RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #5

ACTION ITEM 4-8

Revision to Appendix I to Prohibit Sliding Window error Correction

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SUMMARY
At Meeting #4, it was agreed to prohibit the use of the sliding window error correction technique in connection with the enhanced decoding techniques because of its high undetected error rate in high interference environments. **This working paper presents a proposed change to Appendix I for this purpose.**

I.3.3.2 Sliding Window Technique

This algorithm operates by examining successive 24 bit windows, starting with bits 89-112 of the message. In order to achieve a successful error correction, each message bit in the window corresponding to a one in the error syndrome must have its value complemented (i.e., a one is changed to a zero and a zero is changed to a one). This complementing can only be done if each of the bits is declared to be low confidence. If so, each of the bits is complemented and the message is declared to be error corrected. If not, the window is shifted one bit downward, a transformed syndrome is computed and the process repeats. The process ends when a correctable error pattern has been found, or the sliding window reaches the beginning of the message. In order to control undetected errors, correction is not attempted if there are more than 12 low confidence bits in the window.

This technique provides error correction in cases where a Mode S message has been overlaid with one stronger Mode A/C fruit (that caused all bit errors) and one or more weaker Mode A/C fruit that were above the dynamic threshold (and caused only low confidence bits). This technique is well suited to the low levels of Mode A/C fruit observed in a narrow-beam Mode S interrogator or a TCAS. This technique is not appropriate for high fruit rate environments since it produces a high undetected error rate; ~~-~~ for this reason, its use is prohibited in Section 2.2.4.4.

I.4.3.2 Conservative Technique

The sliding window technique is suitable for the low fruit environments of a rotating beam antenna (long range, narrow beam) or a TCAS (omni directional, short range). However, the fruit environment for the long-range air-air application (which uses omni-directional antennas) may be very severe and ~~it is not appropriate to use~~ therefore the sliding window technique can not be used due to undetected error considerations.

For the very severe fruit environments, a simpler approach, known as the conservative technique is used. Using this technique, error correction is only attempted if all of the low confidence bits in the message are within a 24-bit window, and there are no more than 12 low confidence bits. This constraint limits the application of error correction to signals that nominally had only a single overlapping stronger Mode A/C fruit. This is a conservative approach in that the conditions for attempting error correction are much more restrictive than with sliding window. It produces a lower level of successful error correction since it does not attempt to correct messages with multiple Mode A/C overlaps. However it produces a very low undetected error rate, as intended.

If the conditions for applying the conservative technique are met, the error syndrome is generated for the window position and (as for the sliding window technique) a check is made to see if the ones in the error syndrome correspond to low confidence bits in the window. If so, error correction is accomplished, if not the process is terminated.

If the low confidence bits span less that 24-bits, more than one window could be defined to span them. This will not effect the error correction action, since regardless of the 24-bit window selected to span the low confidence bits, the ones in the error syndrome will identify the same message bits. That is, if the window is moved one bit, the error syndrome will shift by one bit.

Note that in the above description, there is only one possible successful error correction possibility. Regardless of the specific 24-bit window position, the same message bits are identified. All of the bits corresponding to a one in the error syndrome must be complemented. This can only happen if they are all low confidence. Therefore, there is at most, one correctable error pattern that can be achieved with the conservative error correction technique.