RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS

Meeting 6

Getting Accurate UTC Time for Passive Ranging

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SUMMARY
This paper is submitted in support of Action Item 4-16: "Is getting accurate enough UTC time for range validation achievable in low cost GPS receivers?" **The answer is, "YES."**

While not attempting to define "low cost," our local GPS experts at UPS Aviation Technologies inform me that a GPS WAAS engine can provide a time mark pulse that occurs approximately once per second, with a tolerance on the accuracy of the time mark pulse that is well under 500 nanoseconds. Adding another 200 nanoseconds for the rise time of the pulse (as specified in ARINC 743A, Attachment 8) gives an accuracy on the time of occurrence of the time mark pulse that is well under 700 nanoseconds.

Cable delays between the GPS receiving antenna and the GPS receiver, or between the GPS receiver and the ADS-B transmitting device (e.g., Mode S transponder) can be calibrated out if necessary. These would be on the order of 10 nanoseconds per meter. Thus, if the total cable length (antenna to GPS receiver, and GPS receiver to ADS-B transmitting or receiving device) were less than 30 meters, I would expect that the accuracy of the time mark pulse with respect to UTC would still be within 1 microsecond.

Let us allow 1 microsecond tolerance for the accuracy of the time mark pulse on board the transmitting aircraft as delivered to the ADS-B transmitting device. Let us allow another 1 microsecond tolerance for the accuracy of the time mark pulse on board the receiving aircraft as delivered to the ADS-B receiving device. To be pessimistic, allow another 1 microsecond for processing delays in the ADS-B transmitting and receiving subsystem. That gives us a tolerance of 3 microseconds for the passive range measurement accuracy. Radio waves travel at about 300 meters per microsecond, so 3 microseconds translates to a range accuracy of 900 meters, or about half a nautical mile.

I think that even an accuracy of 1 nautical mile is sufficient for the purpose of validating the range from the ADS-B transmitter to the ADS-B receiver. I conclude, therefore, that accurate enough UTC time for this application is can be achieved from GPS receivers.