

## **February 27, 2003 WG4 Telecon**

### ***Participants:***

Jonathan Hammer (MITRE CAASD)  
Steve Koczo (Rockwell Collins)  
Joel Wichgers (Rockwell Collins)  
Sheila Mariano and Paul Lipski (FAA, Seattle)  
Stuart Searight (FAA)  
Michael Petri (FAA)  
Ann Drumm (MIT LL)  
Jerry Anderson (FAA)  
Tim Rand (Rockwell Collins)  
Lynn Martin (San Jose St – NASA Ames)  
Bill Petruzel (FAA)  
Marin Eby (Source Code Systems)  
Jim Maynard (UPS-AT)  
Andy Zeitlin (MITRE CAASD)

### **Agenda:**

- 1) Review of Airborne Conflict Management (ACM) – Tim Rand

#### ***Tim Rand – ACM Review***

Tim provided an 8 page handout that discusses the issue of altitude / altitude integrity in ACM. Tim commenced the discussion.

Tim initially used 1200 ft as an altimetry bound in his initial estimate and used  $10^{-5}$  as an integrity limit from previous fault tree limit.

Tim has changed this initial number to a range of 800 to 1200 ft.

On page 80 (new stuff), Tim address Altitude Reporting Requirements for ACM.

Altimetry Option 1 – RVSM provides 1000 ft separation between 29000 to 41000 ft flight levels.

$10^{-5}$  integrity is achieved at approximately 460 ft altitude containment (referring to Figure 18).

Altimetry Option 2 – Using existing altimetry equipment. Tim noted that we cannot use this existing altitude capability for ACM since it provides insufficient integrity. For

autonomous ACM, we cannot take advantage for having aircraft separated laterally to achieve additional separation integrity.

Altimetry Option 3 and 4 – Option 3 suggests defining a new Barometric Altitude Quality (BAQ) code that supports ACM. Option 4 suggests new definitions of an altitude NIC and an altitude SIL.

Stuart noted that BAQ coding (BAQ = 3) in DO-242A allows a code to reflect RVSM requirements. The question was raised if ACM will require a BAQ of 3? It would be preferred that ACM altimetry requirements not be that stringent.

Jonathan - Transmitting BAQ is part of the overall definition of Service Levels.

There likely is sufficient coding space for including more altimetry quality information (e.g., in BAQ and / or Service Level fields).

RVSM is also about a number of maintenance requirements that aircraft must undergo.

Jonathan – The ACM probing analysis was to address enroute scenarios above a certain flight level, i.e., it does not cover all cases of type of aircraft and operations.

Jonathan – why is the focus of the analysis so much on baro altitude, when we have geo altitude information available for surveillance? Jim – if aircraft are not flying by geo altitude, this may be an issue for using geo altitude for ACM.

Andy – Q on ACM operational concept. Doesn't ACM need to protect against any traffic, regardless of whether they are RVSM or other capable? Tim – ACM covers that, but may have to give traffic a wide berth in altitude or laterally. Tim – we don't want to just look at using ACM for large aircraft, but apply it to a broader set of end users. This is beneficial to all.

Tim Q to group – do we want to set some minimum altimetry requirement (i.e., integrity and containment) for ACM?

Sheila - FAA is working on a paper that addresses the use of geometric altitude.

Currently fielded GPS receivers are typically TSO C-129. For WAAS, TSO C-145A (?) applies.

There was discussion on the type of scenarios we are addressing in the ACM probing analysis. Tim noted that an ANSD of 2 nmi without a specific altitude range in mind would be addressed (not just limited to air transport type category aircraft, but wider range of users).

Tim – even with RVSM, this is marginal for ACM, particularly at lower altitudes.

For RVSM, an altitude hold system is required, to which 65 ft of altitude performance is allocated (flight technical error - FTE). Without an altitude hold system, Tim was assuming an FTE of 200 ft (this is based on pilot training for small aircraft; this may differ for large transport aircraft being flown manually (?)). Tim is addressing RVSM from a Total Vertical Error (TVE) perspective.

Tim suggested adding another 200-300 ft of buffer for ACM, which results in ~800 ft to 900 ft. Michael suggested that this 200 to 300 ft buffer is not broadcast (the importance is to broadcast where the aircraft is actually located rather than where it may be intending

to be), but is instead included within the ACM application as a buffer as part of the trajectory uncertainty. Jonathan and Sheila agreed with this.

Paul recommended that we double check on the size of the altimetry error over a long period of time with the concern that if aircraft are not sufficiently maintained, this error may grow with time / age.

Tim Q - for which altitude source do we need to specify integrity; baro, geo, or both.

Martin – we either reduce 10-5 integrity to allow existing altimetry systems to provide the needed altitude data, or we need to develop new altitude technologies. We are flying 1000 and 2000 ft altitude corridors today. It was noted that ACM introduces more stringent integrity requirements over today's operations, including RVSM.

Jim – ACM could detect when there is insufficient altitude integrity information available, then the algorithm could resolve the encounter in the lateral direction.

Tim – ACM always will do the best it can with the information it has available to it.

Joel noted that we need to know what is the 'minimum' requirement versus allowable 'degraded' performance requirements.

***Jonathan Q1 – do we need a vertical integrity minimum requirement for ACM, or do we allow aircraft without vertical integrity to participate in ACM?***

Tim – he would like to see a vertical containment and integrity, but it could be allowed to be bigger.

Martin – we could just use baro to separate aircraft, as today. The group disagreed to this (there are other altitude cross checks and mitigations that occur today).

***The group agreed to this question by agreeing to the need for altimetry integrity.***

**Action item – WG1 CD&R subgroup to take this decision back to WG1.**

***Q2 – if we have a requirement on vertical integrity, we have the choice of RVSM or have to have a NIC of 9 or better for ACM.***

***The group agreed that we have to have integrity on baro altitude.***

Paul commented that it is probably inadvisable to allow a reduced altitude integrity than 10-5 could be used for the type of maneuvers that occur for ACM resolution advisories, subject to fault tree analysis. The group agreed that the integrity numbers from the fault trees and / or any other analyses stand on their own based on careful analysis and validation.

Jim suggested that one can offload integrity requirements on the altitude source to improved performance on the the ACM algorithm (by the ACM algorithm providing improvements in separation assurance).

Discussion about the 10-5 lateral SIL requirement; was this a minimum requirement, or is it what is achievable.

Andy is doing the ACM buddy review on the fault trees.

**Action item – Tim to examine the additional tolerance to be included with the 400 ft RVSM vertical allocation.**

Tim provided an overview of the status of his ACM action items ‘a’ through ‘g’ (from Nov. 19, 2002 meeting). Michael will look at the actions to see if they are completed. Action item ‘g’ remains open.