

**SC186 WG4 Redmond, Washington, June 2001
Meeting Minutes**

Attendees:

Jerry Anderson, FAA/AIR-130
Randy Bone, CAASD
Jim Cieplak, CAASD
Lee Etnyre, UPS AT
Jonathan Hammer, CAASD
Bob Hilb, UPS
Bill Morris, PMA209/Raytheon
Steve Koczo, Rockwell-Collins
Gerry McCartor, FAA/AFS-420

Michael Petri, FAA WJH Technical Center
Greg Stayton, L3 Communications
Gene Wong, FAA/AND-530
Andy Zeitlin, CAASD
Mike Ulrey, Boeing
Pio Blankas, Honeywell
John Brown, Boeing
Ruy Brandao, Honeywell
Richard Barhydt, NASA Langley

Monday - June 4 (WG4 Meeting)

1. Review of ASA MASPS Document – Chapter 1

The group reviewed the draft inputs from Randy Bone on Section 1.4 – ASA Applications. Randy’s inputs were accepted with some minor edits made. The chapter 1 review was resumed later in the meeting (i.e., on Wednesday), where Sections 1.2 – System Overview (Dave Spencer and Steve Koczo draft inputs) and Section 1.5 – Operational Goals (Steve Koczo draft inputs) were also reviewed. Chapter 1 is now considered to be a mature draft by WG4.

Since many of the sub-system context diagrams were removed from Chapter 1, the group discussed moving these diagrams into Chapter 3 of the MASPS, where requirements allocations for each of the ASA subsystems will be documented. No specific edits were made, but this approach will be pursued for future edits.

2. RXX / Service Levels / Chapter 2 Organization

The group next discussed RXX (ASA-level Required Surveillance Performance) and ASA Service Levels. The group continues to explore an appropriate grouping of ASA application performance requirements into a succinct group of Service Levels. These Service Levels are intended to classify ASA platform architectures based on minimum Required Surveillance Performance and equipment necessary to accomplish the desired operational objectives for a particular ASA application. The goal is to define Service Levels that group applications as a set of saleable applications / packages, each with increasing capability and with the ability to perform applications of the previous service level. I.e., Service Level 0 is considered the lowest-end / entry level grouping, with succeeding levels having greater capability. The goal is to try to align the service levels with ADS-B MASPS equipment levels (A0 ... A3) if possible.

Definition of specific Service Levels has been hindered by the lack of available application performance requirements. While a notional grouping of applications has been identified by WG4, the group realized that it is premature to finalize any grouping until completing requirements analyses for near-term and probing applications.

The group next discussed the expected make-up, i.e., attributes / parameters that comprise a service level. It is viewed that there will be a set of generic attributes / parameters for each service level (e.g., integrity, continuity, availability, etc). Update rate, latency, accuracy, and coverage volume are also likely part of the generic set of service level attributes / parameters. The group also discussed attributes / parameters that are more specific to individual applications, such as performance requirements provided by “situational awareness,” “guidance,” and “alerting.” These tend to be unique to a specific application. The group had a considerable discussion about how to capture these types of attributes in Service Levels, how to capture them in Chapter 2 and then subsequently allocate in Chapter 3 for the subsystem allocations. This issue was not resolved and will require further discussion. One potential approach was to capture the generic attributes in the service levels in Chapter 2, then allocate them to subsystems and requirements in Chapter 3. Application-specific / unique attributes would then be identified in Chapter 3. This will continue to be a further action item for the group to resolve.

Tuesday – June 5 (Joint WG1 – WG4 Meeting)

3. Review of ASA MASPS Work Matrix

Jonathan Hammer kicked off the joint WG1 – WG4 meeting by presenting a Work Matrix of planned activities and the organizations responsible for these activities (See table 1, below). The rows of the Work Matrix represent the ASA near-term and probing applications. Columns consist of the products / outputs that will be provided by various groups / organizations that will provide inputs needed to complete the ASA MASPS. Some of these activities are being funded by FAA in order to expedite the development of ASA MASPS requirements through analyses efforts. Analyses / study outputs in the columns of the matrix are 1) application description documents (provided by WG1), 2) application state diagrams (WG1 and WG4 products), 3) hazard tables / safety analyses, 4) fault tree analyses, and 5) requirements analyses for normal operations. It was noted that some of these activities (generally viewed as being completed in an ~ 10 month time frame), have been delayed in getting started due to the time required to get contracts in place. **Due to the delay of starting these analyses, there is risk that a completed draft of the ASA MASPS may also experience some slip in the planned December, 2001 date. It is anticipated that substantive draft material will be available for plenary review in December, however.**

| Application | Description / Scenarios | State Diagrams | Safety Table | Fault Trees | Requirements Analysis |
|----------------------------------|--|--|--|--|--|
| EVA's | WG1 / Randy Bone <i>Complete</i> | WG1 / Randy Bone <i>July</i> | WG4 Safety SG <i>95% Complete</i> | Lincoln Lab -- Dave Spencer <i>First draft complete</i> | Lincoln Lab -- Dave Spencer <i>Projected completion in August</i> |
| CSPA Probe | OK City / L3 <i>Draft for August review</i> | OK City / L3 <i>Draft August</i> | OK City <i>Date depends on contract</i> | OK City <i>Date depends on contract</i> | OK City <i>Date depends on contract</i> |
| ACM - CD&R probe | WG1 / ACM Subgroup <i>2nd draft September</i> | WG1 / Collins <i>Draft September</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> |
| ACM - conflict detection | WG1 -- ACM Subgroup <i>Final Draft: July 19</i> | Michael Petri / ACM SG <i>Draft: July 19</i> | UPSAT (tentative) <i>Date depends on contract</i> | UPSAT (tentative) <i>Date depends on contract</i> | UPSAT (tentative) <i>Date depends on contract</i> |
| Surface -- Situational Awareness | WG1 <i>2nd draft complete; 3rd draft 6/30</i> | Randy Bone / Collins <i>Review by August meeeting</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> |
| Surface -- FAR-OA | WG1 <i>2nd draft complete; 3rd draft 6/30</i> | Randy Bone / Collins <i>Review by August meeeting</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> | Collins <i>Date depends on contract</i> |
| Approach Spacing Probe | CAASD <i>Draft 6/30</i> | CAASD <i>Draft complete</i> | CAASD <i>7/31/01</i> | CAASD <i>8/31/01</i> | CAASD <i>9/30/01</i> |
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Table 1: ASA MASPS Activities / Support

Gene Wong, FAA, summarized the FAA contract work being supported. Some of the task contracts planned are for FAA Oklahoma City (Flight Standards) for Closely-Spaced

Parallel Approaches, UPS-AT for Conflict Detection, Rockwell Collins for Conflict Detection and Resolution (CD&R) probing analysis, and the surface applications (FAROA and ASSA), and the work efforts for MITRE and MIT. The joint WGs identified expected completion dates for the various tasks in the Work Matrix, with some dates yet to be determined based on schedule contract start dates.

It was noted that there will be a need to review and integrate the results of these studies and analyses (for the various applications) to ensure consistency. WG4 or some subgroup of WG4 is expected to provide this review and consistency check role. In addition, it was noted that use of the same tools, e.g., the fault-tree programs, is desirable for consistent results.

A number of actions items were identified as part of the Work Matrix schedule:

Gerry McCartor – provide dates for CSPA analysis tasks.
Steve Koczko – provide dates for CD&R, FAROA, and ASSA tasks.
Gene Wong – contact NASA to obtain CSPA application description / ops concept documents (Barry Sullivan – NASA contact)

4. Review of ACM versus Near-Term Conflict Detection – Bob Hilb

Bob Hilb presented the Draft Conflict Detection (CD V0.6) document completed by WG1. Three distinct categories / areas of operation for CD were discussed (GA traffic pattern, terminal area, en route). The following are a list of issues identified / discussed:

- Maneuvering using the CDTI - initial focus will be on only being able to maneuver based on visual information. Maneuvers based on CDTI will be addressed later.
- Type of alerting needed / assumed for CD. Some in WG1 want notification alert if an aircraft enters into the GA pattern. Alerting from the perspective of conflict prevention is not considered initially (it is outside the CD concept but is part of ACM).
- Discussion about the numbers entered in the Tables for the 3 CD categories (alerting times, size of PAZ / CAZ zones, etc). These need to be validated by analyses. In addition, numbers for alerts, e.g., 10^{-4} , 10^{-5} probabilities are expected to be the outputs of WG4 requirements analyses based on the ops concept inputs from WG1.
- Pilot selectable PAZ zones to override fixed zones was discussed.
- Discussion of the VFR / IFR Safety Hole that exists in today's operations (IFR aircraft in VFR airspace, aircraft basically in VFR separations; IFR aircraft popping out of cloud and being right next to a VFR aircraft)
- Issue: Use of the PAZ to achieve legal separations.
- Issue: CD application would be more capable than the ground system; why can't we use the improved system (smaller PAZ?) – concept doesn't match well with current system.
- CD is based on having a display, but doesn't preclude use of aural-only alerts

5. Group Discussion of Full-ACM / CD&R / Short Term Intent / Long Term TCPs

The group discussed the relationships of full-ACM applications and the use of various intent information in order to try to clarify the expectations for pending probe analyses for CD&R. The following notions / views of what should be addressed were raised by various group members:

- Bob Hilb - keep the analysis to the PAZ/CAZ level, i.e., no TCPs. TCPs were viewed to be only needed for Low-Level alerts and long range deconfliction and shouldn't be the focus at this time (LL is viewed to be more of an economic consideration to support shorter routes).

TCPs increase the complexity of the ACM apps considerably, and we shouldn't go down this road for the initial ASA MASPS (even for probing analysis).

- Mike Petri - self-separation should be the focus; examine long surveillance range; analysis should consider the various options available for CD&R using various forms of intent data.
- Martin Eby - including TCPs will add significant scope to any analysis that already considers running scenarios and simulations. Risk for many wrong assumptions unless a full ops concept is available.
- Tony Warren – TCPs have utility for air-to-ground applications being considered by Boeing and in Europe. Tony is skeptical that state information alone is adequate for conflict resolutions and there may be a need to broadcast resolution information. Next version of DO-242 ADS-B MASPS has changed from TCPs to short term intent information (e.g., next target state information such as 'selected altitude'). For specific FMS aircraft, interaction between short term and long term intent information needs to be addressed.
- What are the relationships and needs for 1) state vector, 2) short term intent (selected altitude, heading), and 3) long term intent by ACM applications?
- Jim Cieplak – do we use TCPs for CD&R? It would be beneficial if we could investigate / develop / analyze the CD&R application as a growth path from the currently planned conflict detection equipment development intended for Alaska.
- Jonathan – What is the time frame for the ACM concept? Bob H. – September draft will say little about TCPs. TCPs would lengthen the time of the analysis.
- Jonathan - Short-term intent information is of interest to WG4; how does this tie into the CD&R probe analysis (if at all)?
- Jonathan – Reason for probe analyses are to assure that vendors are happy that systems aren't throw aways. Greg Stayton – we should come as close as one reasonably can – we will not get everything correct.

The conclusion on the planned CD&R probe analysis is that anything beyond using velocity vector information will not be included. An attempt will be made to integrate Tony's work (short term and long term intent) as best as possible.

The CD&R probe analysis, and the WG4 intent subgroup efforts on short-term intent, and long-term intent are planned to be captured in one or more appendices

of the ASA MASPS. Further discussion of this subject will take place in an upcoming teleconference of the intent subgroup.

6. State Diagram Discussion

Randy Bone kicked off the state diagram discussion by presenting state diagrams for the Approach Spacing probing application. Three state diagrams were briefed from the perspectives of the flight crew, air traffic control, and the equipment.

Greg Stayton then presented his state diagrams for the Closely-Spaced Parallel Approaches (CSPA) probing application.

The group is still trying to sort out the exact format for the best and most consistent description of the application state diagrams. After some discussion, the value of using state diagram descriptions was reconfirmed. State diagrams are thought to be a good vehicle for describing the application states and transactions (i.e., the stimuli) within an application and are expected to allow WG4 to effectively identify potential failures that can lead to operational hazards for the ASA applications. These then serve as an input to the safety / fault tree analyses.

The group concluded that state diagrams are the preferred method for describing and capturing the application and to integrate the flight crew, air traffic control and equipment perspectives into an integrated state diagram. The next step for WG4 is to clarify this specific method for representing the application states. **Mike Ulrey, Dave Spencer, Greg Stayton and Randy Bone have the action item to further develop the state diagram method using the Approach Spacing and CSPA state diagram as a starting point.**

Andy Zeitlin also noted that both the fault tree approach and the state diagram approach are warranted for our development and analysis of ASA application requirements. Fault trees are very good at dealing with multiple events but are not good at dealing with sequences of events. State diagrams on the other hand are good way to deal with sequences. The group is planning to continue with both the fault tree and state diagram approaches to develop the ASA MASPS.

Note: WG4 had an additional discussion concerning the state diagram method on Wednesday AM. Mike Ulrey offered some additional thoughts on how best to capture ASA MASPS application requirements using the state diagram method and gave an overview of a state chart and fault analysis tool being used at Boeing. Mike demonstrated an example of the Rhapsody tool made by I-Logic Corp. (Mike noted that Boeing had been using Cadence's BONES discrete event simulator program but this tool was no longer being supported by the vendor). Boeing is using the Unified Modeling Language (UML) standard language that supports a graphical method for capturing diagrams of a system in a number of views (state diagram, activity diagram view, and object model views of the system to be analyzed). The Rhapsody tool allows one to generate a "case diagram" that captures what one wants the system to do, i.e., the

application, which generates C++ code to simulate ones system. “Use cases” are then used to represent the test cases which can verify the system.

Tony Warren noted that we have 2 needs for the safety analysis: 1) a high-level hazard assessment and criticality analysis of a respective ASA application, and 2) a detailed validation and verification of the low-level application details. It was noted that the detailed validation and verification would require use of the type of tool identified by Mike Ulrey. However, it was also noted that the high-level hazard / criticality assessment could be accomplished without such a tool (although the tool would definitely be of benefit).

Greg Stayton also noted that use of such a tool raises a number of considerations / issues:

- What tool do we use?
- Who owns the tool? Is the it proprietary?
- Who and how many people are trained in the tool?
- How is the tool maintained?
- Is our system complex enough to warrant capture using this tool?

After further discussion it was agreed that a simple tool, low cost tool might be adequate for our needs. Michael Ulrey is investigating such a tool.

7. ASA Application Descriptions Review

As part of the ongoing dialog between WG1 and WG4, Randy Bone presented the application descriptions from WG1 as an input to WG4 for the Airport Surface Situational Awareness (ASSA) and Final Approach and Runway Occupancy Awareness (FAROA) applications. Text copies of these applications were distributed.

Randy also indicated existence of another related document for ASSA that is being developed by the SF21 working group (Visual Con Ops for Surface Applications).

Tony Warren noted that SC-193 is requesting changes in the ADS-B MASPS that specify the 1) aircraft navigation center, and 2) aircraft size for the surface applications. Bob Hilb also noted that it is WG1’s position that this information is needed in the ADS-B MASPS for these applications.

8. Intent Subgroup Report – Tony Warren

Tony Warren presented the latest status on the efforts of the WG4 Intent Subgroup work on short-term intent and long-term intent / TCPs. Tony has been working this effort as a probing analysis for WG4 for potential future stressing applications, his interest in air-ground air traffic management applications, and also to support the Ad Hoc effort in developing the next version of the ADS-B MASPS.

The basic question being addressed by the Intent Subgroup is: “How do we transmit intent information that avoids misinterpretation of that information”.

Tony presented several categories of intent information and associated requirements:

- 1) Prediction accuracy – how much uncertainty is acceptable for conflict detection
- 2) Prediction / intent integrity – how much to trust predicted trajectory; how much integrity is needed for conflict resolution
- 3) Tactical separation for short look-ahead encounters, procedural separation

Tony discussed a new notion of remote TCPs (unlike near term intent) that represent future aircraft trajectories using the concept of “tubes in space”, i.e., 4-D tunnels, which serve like a contract by aircraft in future flight path intent (perhaps associated with class A3 equipment).

Tony also described an intent scenario where an aircraft that is currently climbing, with an expected level-off below ownship. If the aircraft does not level off, a conflict would ensue. He indicated that the avionics system may need to also transmit that the aircraft has in fact undergone a state change that indicates that the level-off has been actuated. This requires that this state change information must be transmitted in order to check that the intended path is actually being followed; otherwise the current trajectory (i.e., climb) would need to be extrapolated forward to detect the possible threat.

Tony has submitted an issue paper with the ADS-B MASPS Ad Hoc committee. He inquired whether this information also needs to be addressed in the ASA MASPS. He viewed the “tubes in space” concept as being 5 years out (i.e., it is part of a long-term probe analysis for CD&R / ACM), while flight mode indicator intent information (i.e., selected altitude / heading) is part of a short-term probe analysis. **European / NLR TCP interests should also be considered for potential probe inputs to the ASA MASPS.**

9. Update on Ad Hoc ADS-B MASPS – Tom Foster

Tom Foster briefed the group on the ADS-B MASPS update. He indicated 40 issue papers have been submitted (23 are active for Revision A, 4 deferred, 5 rejected, and 8 are closed). He noted that these are all found on the following web site:
<http://adsb.tc.faa.gov>

His schedule indicates that the issue list for Revision A will be frozen in early June. 1st draft of Revision A of the ADS-B MASPS is planned for September 10, draft to RTCA by November 5, with approval by December 14.

Tom identified some of the issues that pertain to WG4 and WG1:

- 1) NIC, NAC, probability levels
- 2) TCP intent issue
- 3) Reorganization of State Vector and Mode Status information

- 4) Capability codes, aircraft size, certified navigation center, anonymous ID, on condition report to include air vector data for all aircraft, short term intent (selected altitude, heading, flight mode)

For surface, consider heading being set equal to track (addendum to an existing issue paper). Tom identified the issue on whether the ADS-B MASPS should include support for down link information for “enhanced surveillance data” that is of interest in Europe, while airlines are generally not supportive of this.

Tom raised the issue of “short term” intent information; how should this be handled, as part of an appendix or as part of an application? This is still viewed as part of future applications. Jonathan suggested that this could be captured in an appendix in both the ASA MASPS and ADS-B MASPS. Tony was concerned that this information would be ignored if it was put in an appendix, and noted that a lot of work has been done. Bob Hilb noted that we need to address both, the application and the intent information and that Tony and the Intent Subgroup should brief WG1 on this. Bob is concerned about eliminating TCPs from Revision A of the ADS-B MASPS. A joint WG1/WG4/Ad Hoc telecon was recommended to address this.

Tom provided a brief overview of European interests and harmonization activities. He noted that Europe was not ready to buy into a joint ADS-B MASPS (Revision A), but that they desire development of a joint ASA MASPS using a top-down approach. Tom noted European interest in TCPs, i.e., FLIPCY (flight plan consistency), and that Europe is currently more interested in Air-Ground applications.

10. Review of FAA/Eurocontrol Principles of Operations for ASAS – Gene Wong/Andy Zeitlin

Gene Wong and Andy Zeitlin provided an update on the Principles of Operation (PO) for the use of ASAS document. Gene noted that this document is an output of Action Plan 1 (AP-1, one of twelve action plans), to provide the airborne separation concept document that is meant to provide guidance to the industry. The PO for ASAS is a joint output by an FAA and Eurocontrol R&D oversight committee; they have been holding 2 yearly meetings and 2 telecons. Version 6 has been reviewed and comments have been integrated into version 7. This document attempts to harmonize terms and concepts and provides the notion of “airborne separation minima”, a concept that currently does not exist.

11. Safety & Fault Tree Subgroup Report – Andy Zeitlin

Andy led the discussion of our latest update of the Hazard Table for the Enhanced Visual Approaches application. The group discussed the issue of the criticality “class” category for the application for various operational hazards. Previously, the class ratings were in the range of 4 and 5 (minor and no effect, respectively). However the group realized that our initial class ratings included the credits of mitigations and avoidances. The group concluded that this was not the intent of the class categories. The “class” rating should

be commensurate with the severity if the operational hazard were allowed to occur (without avoidances, mitigations, and probability of occurrence). Some of the class ratings were increased considerably in the table. Jonathan made electronic edits to the table based on discussions. Jonathan and Andy will review the table and will provide a revised version of the table for the group.

12. Future meeting and teleconference schedule:

Meetings:

- August 7, 8, 9 in Washington DC (RTCA Headquarters)
- October 1, 2, 4 in Europe (tentatively in Brussels), (plenary October 3). October 4 will be joint with the ICAO SCRSP ASAS working group.
- December 4-6 in Washington DC
- February 5-7 (tentatively in Phoenix)

Teleconference schedule:

June 20, 2:30-4:30 PM Eastern

June 27, 1:00-3:00 PM -- Ad-Hoc, WG1, WG4

July 11, 1:00-3:00 PM Eastern (RXX && chapter 2)

July 25, 1:00-3:00 PM Eastern (State diagrams && fault trees)
