

**Minutes of Meeting #6 of SC-186 Working Group 3
Development of Revision A of the ADS-B 1090 MHz MOPS**

The meeting was called to order by Dr Vince Orlando at 9am on 21 August 2001, at the Honeywell Learning Center in Redmond Washington, hosted by Pio Blankas, who welcomed us to Redmond and informed us about the Honeywell facilities. Dr. Orlando welcomed all attendees, and asked that each attendee introduce themselves and their organization. The attendees included:

Mike Culver – Microsoft Corp.	Vince Orlando, MIT Lincoln Lab	Ron Staab, Trios Associates
Gary Furr, Titan Corp. (FAA TC - ACT-350)	Stuart Searight – FAA TC – ACT-350	Tin Truong – FAA Seattle Aircraft Cert.
Bill Harman, MIT Lincoln Lab	Bob Semar, United Airlines	
James Maynard, UPS Aviation Technologies	Kent Sharkey – Microsoft Corp.	

1. Following the introductions, the following known regrets to attendance were announced:
 - Jerry Anderson
 - Greg Kuehl
 - Ron Jones
 - John Van Dongen
 - Bob Saffell
 - Carl Jezierski

2. Following Agenda Item #2, Vince Orlando made a few introductory remarks. He informed the Working Group that the Australians had selected Honeywell and Sensis to supply 1090 MHz ADS-B equipment in response to their RFP. He briefly indicated that there had also been some recent email inquiring about the minimum level of transponder for implementation of Extended Squitter. The answer is that implementation of Extended Squitter requires a minimum Level 2 transponder.

3. The Working Group reviewed the Minutes of Meeting #5 held at the FAA William J Hughes Technical Center. Hearing no objection, the Minutes of Meeting #5 were approved as published.

4. The Working Group reviewed and discussed the locations, dates and times of the meetings that were scheduled, and agreed to add several meeting dates in early 2002 to the tentative schedule. The following table indicates the currently agreed upon meeting dates and places for proposed future meetings of Working Group #3 for the production of Revision A of the 1090 MHz MOPS (RTCA/DO-260).

Dates/Time	Meeting Place
Wednesday, 17 October at 9am through 5pm, Thursday, 18 October 2002	Confirmed at MIT/Lincoln Laboratory Aviation Liaison Office Portals Building, Washington DC See the 1090 web site for travel maps and lodging information
Monday, 3 December at 9am through 5pm, Thursday, 6 December 2001	Meeting Site is being negotiated for London, but not 100% confirmed yet. Meeting location should be the CAA-House in Kingsway, central London Lodging information and maps will be made available ASAP.
Wednesday, 9 January at 9am through 5pm, Friday, 11 January 2002	Tentative meeting site in Ft. Lauderdale, hosted by MIT Lincoln Laboratory Confirmation pending inquiry by Vince Orlando, confirm at Meeting #7 Lodging and travel information will be made available ASAP.
Tuesday, 12 February at 9am through 5pm, Wednesday, 13 February 2002	Meeting location TBD – L3 Communications has agreed to host in Phoenix, AZ
Tuesday, 26 March at 9am through 5pm, Wednesday, 27 March 2002	Tentative meeting location at the FAA Tech Center, Atlantic City, pending determination of dates and time of SC-186 Plenary in 1Q2002

5. The Working Group departed from the agenda to recognize Mike Culver and Kent Sharkey from Microsoft Corporation because of the limited amount of time that they had to present their vision of FIS-B support to the Working Group. This vision includes the use of XML Web Services for the preparation of FIS data to be transmitted over the 1090 MHz, or any other ADS-B data link. Mike Culver will be preparing a Working Paper on the Microsoft approach to FIS-B for presentation at a future meeting.
6. In conjunction with Agenda Item 6, and since Stuart Searight was dialed into the meeting via a conference phone, the Working Group began review of Working Paper WP-6-11 which had been passed on to WG-3 by Stuart Searight as a working paper from Working Group #6 as their proposal to changes to the ADS-B MASPS, DO-242, which will provide necessary accuracy and integrity parameters for ADS-B state vector reporting, and for assessing whether proximate aircraft have sufficient accuracy and integrity to participate in selected separation applications. During discussions of this and other potential MASPS changes, Stuart and Jim Maynard indicated that another white paper on TCP should be forthcoming soon after their next meeting, the week of 27 August 2001.
7. The Working Group then reviewed the List of Open Action Items, as it has been updated for this meeting and in conjunction with Agenda Item 7, we started the review of Working Papers, which resulted from those Action Items, with Working Paper WP-6-01, presented by Gary Furr. This Working Paper suggested a “Note” to be added to subparagraph 2.2.3.2.7.1 regarding the current status of TCP/TCP+1. The Working Group agreed to implement the Note, as modified during the discussion and documented in the revision to the Working Paper as WP-6-01A, which will be posted on the ADS-B 1090 web site following the meeting. Further, Item #12 was added to the Orphan Issues List so that the Working Group would not forget that in the event that the “TCP Data Valid” flag is still set to zero (0) when we get closer to publishing DO-260A, we must make a decision as to whether or not we require any testing of any TCP/TCP+1 paragraphs in Section 2.4. The modified subparagraph as outlined in WP-6-01A will be documented as an agreed upon change to DO-260 and posted on the ADS-B 1090 web site.
8. Next, the Working Group reviewed Working Paper WP-6-05 as presented by Vince Orlando. This Working Paper proposed an answer to the question of why DO-260 limited the use of a non-transponder device (NTD) to Class A0. The answer is that the NTD does not use the spectrum as efficiently, or provide the system benefits that can be obtained with a transponder implementation of Extended Squitter. The Working Group agreed that the Note as proposed in the Working Paper should be inserted at the end of subparagraph 2.2.2.2. The modified subparagraph will be documented as an agreed upon change to DO-260 and posted on the ADS-B 1090 web site.
9. While still reviewing Open Action Items, Jim Maynard presented WP-6-07 in response to Action Item 4-16, as an answer to the question of whether or not getting accurate enough UTC time for range validation is achievable in low-cost GPS receivers. The short answer was “Yes.” Given Jim’s analysis, based on his interviews of his GPS experts, he concludes that an accuracy of about 900 meters, or half a nautical mile can be achieved. Given that we believe that 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, the Working Group agreed that accurate enough UTC time for ranging could be achieved from low-cost GPS receivers. However, a possible design change to Extended Squitter, to incorporate one-way ranging was discussed at this point and at several previous meetings. While the design change appears to be feasible in newly designed avionics, it would be quite difficult to incorporate such a change in existing transponder designs. Therefore, it was agreed by the Working Group that one-way ranging will not be included in the Extended Squitter MOPS.
10. Continuing with his response to Action Item 3-2, Gary Furr presented WP-6-08 as his suggested changes to Sections 2.2 and 2.4 as a result of the implementation of the Version Number originally

agreed to by WG-3 during Meeting #2, and documented by Vince Orlando in WP-3-01A. In WP-6-08, Gary outlined those sections in 2.2 and 2.4 where changes should be implemented, but did not actually make those changes and present them to the Working Group. As a result of discussions on the suggested changes, several agreements were reached by the Working Group.

- A. Gary's suggestion that the Version Number be inserted into the State Vector Report was not approved. Instead, it was agreed by the Working Group that the Version Number would be inserted into the Mode Status Report as item #17. Appropriate sections in 2.2 and 2.4 will be changed accordingly.
- B. It was agreed by the Working Group that the Aircraft Operational Status Message must be transmitted more frequently than the rate described in DO-260 subparagraph 2.2.3.3.2.6.3. The Working Group proceeded to make revisions to subparagraph 2.2.3.3.2.6.3 by deleting subparagraph 2.2.3.3.2.6.3.(a), renumbering existing subparagraph 2.2.3.3.2.6.3.(b) to 2.2.3.3.2.6.3.(a) and making changes to subparagraph 2.2.3.3.2.6.3 as follows:
 - a. The Aircraft Operational Status Message (subparagraph 2.2.3.2.7.3) shall be broadcast at random intervals that are uniformly distributed over the range of 1.6 to 1.8 seconds relative to the previous Aircraft Operational Status Message.
 - b. In the event that the values of NIC or NAC or SIL decrease, then the Aircraft Operational Status Message shall be broadcast at random intervals that are uniformly distributed over the range of 0.5 to 0.7 seconds relative to the previous Aircraft Operational Status Message, for a period of [12] seconds. During this [12] second period, the Aircraft Trajectory Intent Message(s) shall not be transmitted.
 - c. Exceptions to these transmission rate requirements are defined in subparagraph 2.2.3.3.2.9.
- C. It was agreed by the Working Group to further add a new subparagraph 2.2.3.3.2.6.1.(c) as the following statement: "Aircraft Trajectory Intent Message(s) shall not be transmitted during the high-rate transmission of the Aircraft Operational Status Messages as defined in subparagraph 2.2.3.3.2.6.3." The existing subparagraph 2.2.3.3.2.6.1.(c) will be renumbered as "(d)."
- D. Further, during discussion of how the Version Number affects Track initiation, it was agreed by the Working Group that when we deal with the Version Number subfield in the Report Assembly Function, we must assume a Version Number of zero (0) until it is established through the receipt of a Mode Status Report that the Version Number is different.
- E. Finally, it was agreed by the Working Group that the Version Number as identified in the Aircraft Operational Status Message, originally defined by Vince Orlando in WP-3-01A, would become a 3-bit subfield instead of the 4-bits identified in WP-3-01A. This change affects the proposed new subparagraph A.4.11.11 and the proposed changes identified for Figure A-12.

Action Item 62 was accepted by Gary Furr to use WP-6-08 as a starting point for presenting the actual DO-260A modified text which would result when the suggested changes identified in WP-6-08, as well as those discussed during Meeting #6 and documented above, were implemented for each suggested change in Section 2.2 and 2.4. A new Working Paper will be presented at Meeting #7 showing these changes.

- 11. In response to Action Item 4-10, Bill Harman presented Working Paper WP-6-09 as suggested MOPS changes to accommodate enhanced DMTL techniques. In previous WG-3 meetings, it was noted that several needed MOPS changes were related to DMTL. One change was needed because we have identified two different ways of using DMTL. Bill believes that the MOPS should identify both and make it clear that both are allowed. WP-6-09 proposed changes to Appendix I to accomplish this.

Additionally, other changes were proposed in WP-6-09 because existing DMTL requirements in Section 2.2 would contradict the enhanced techniques. The Working Group discussed each of the proposed changes and agreed to each change identified in WP-6-09. Changes were made to Appendix I during the meeting for each proposed change in WP-6-09, and a revised Appendix I will be posted on the ADS-B 1090 web site following the meeting.

12. As part of Agenda Item 8, Bill Harman presented WP-6-12 as a status report on the simulation to obtain values of reception probability. Bill indicated that the simulation portion of the work has progressed well since the previous WG-3 meetings and that WP-6-12 presented the recent simulation results and described the status of this work, and the plans for future work.
13. Also as part of Agenda Item #8, Vince Orlando presented WP-6-04 as the fourth draft of the test procedures for enhanced surveillance processing as proposed for the requirement in 2.2.4.4 and the test procedures starting with 2.4.4.4. During review of WP-6-04, it was pointed out that the test procedure sections contained the word “shall,” which is a reserved word that creates a requirement in a MOPS document. Vince indicated that it was basically a requirement of the test equipment to be used in the specific test procedure. Vince did agree in **Action Item 6-3** to remove the word “shall” from the test procedures and re-word the paragraphs to indicate that certain test equipment was required for adequate testing.
14. Moving to Agenda Item #9, Vince Orlando presented WP-6-06 as the third draft of the material proposed for Appendix A for TIS-B. Vince explained the changes in this material from the second draft that was reviewed at Meeting #5 and agreed in **Action Item 6-7** to continue completing Appendix A material for TIS-B for presentation at the next meeting.
15. Also in conjunction with Agenda Item #9, Vince Orlando presented WP-6-13 as Draft one of the proposed changes to Section 2.2 as a result of TIS-B. At a previous WG-3 meeting it was agreed that the TIS-B material would be inserted into DO-260A at subparagraph 2.2.17. This served as the starting point for the material presented in WP-6-13, which was basically an annotated outline. **Action Item 6-4** was accepted by Gary Furr to make modifications to all of the proposed tables for message formats presented by Vince in WP-6-13, since they were in Visio, and to return WP-6-13 to Vince for his continued work for the next meeting. Gary completed this work shortly after the meeting, and Action Item 6-4 was Closed.
16. As part of Agenda Item #11, Working Papers WP-6-02 and WP-6-03 were discussed briefly by the Working Group as submissions from Jerry Anderson and Ron Jones. In WP-6-02 Jerry Anderson suggested changes to Tables 2-3, 2-4 and 2-5 because in Jerry’s opinion, State Vector and Mode Status information in those tables does not accurately represent the DO-242 MASPS requirements for Class A0 and B1 equipment. In WP-6-03 both Jerry Anderson and Ron Jones suggest changes to Table 2-5 based on splitting the A2 and A3 classes into two categories, taking into account enhanced reception. However, because of the lightly attended meeting and because neither Jerry nor Ron were available to defend their positions on their Working Papers, it was agreed by the Working Group that both WP-6-02 and WP-6-03 would be deferred to Meeting #7 when both Jerry and Ron would be expected to attend to defend their positions. Gary will place both Working Papers on the Agenda for Meeting #7 in Washington DC.
17. Finally, as part of Agenda Item #11, Gary Furr presented Working Paper WP-6-10, which was a response to a call from a reader of DO-260 who had commented that it took an extraordinarily long time to determine whether diversity is required for Class A1 equipment. It was discovered during a review of DO-260 that the ONLY place in the document that there is a statement regarding diversity being required is in subparagraph 3.3.1, where it is stated that diversity is required for classes A1, A2 and A3. Gary’s proposal would add the words “Antenna Diversity” to a column of Table 2-1 to make it easier for the reader to determine the diversity requirement. The Working Group agreed that the more appropriate place would be the ‘Features’ column of Table 2-1 and that a “Note” should be

added at the bottom of Table 2-1 pointing the reader to subparagraph 3.3.1. Gary will implement the agreed upon text into Table 2-1 and will post the change on the ADS-B 1090 web site.

18. The following **Action Items** were identified at this, or previous, meetings of this Working Group. The asterisk (*) beside a name or organization indicates that they are the lead for the resolution of that Action Item. Actions shown here are those Action Items that will remain OPEN for the next meeting.

Action Number	Action Description	Assigned to	Status
1-7	Compare performance of their non real-time test sets.	MIT/FAATC	Deferred to later meeting
2-16	Draft a candidate SVID Management Message for service volume coverage.	Jim Maynard	
2-17	Review the NL equation at A.7.2.d and possibly reword for latitudes at 87.	Jim Maynard	
4-4	Recommend updates to Sections 2.2 and 2.4 to eliminate range based decoding references and requirements.	Bob Saffell Stacey Rowlan	
4-11	Add material on dynamic bandwidth control for the proposed Appendix M	Bob Saffell	
4-12	Pursue available antenna that provide additional gain in the forward direction and vertical aperture.	Bill Harman Carl Jezierski	3 Antennae ordered, due Nov.
5-4	Incorporate any modifications to WP-5-10A as necessary based on the MASPS meeting discussion, any changes in the Report Assembly Function, and resubmit at Meeting #7	James Maynard	
5-7	Conduct interference testing as described in WP-5-09 and provide required performance for the enhanced surveillance processing techniques in 2.4.4.4	John Van Dongen	
6-1	Check for lists of hotels for London meeting. Obtain the specific meeting location address and any maps if possible.	Vince Orlando	
6-2	Make changes discussed during review of WP-6-08 to sections 2.2 regarding the use of the Version Number subfield. Make changes to corresponding sections of 2.4	Gary Furr	
6-3	Remove specific requirements using the word “shall” from test procedures detailed in WP-6-04 and present Draft 5 at meeting 7	Vince Orlando	
6-4	Make changes to all of the Figures in WP-6-13 and return the file to Vince Orlando for his updating of the next draft of Section 2.2.17	Gary Furr	Done CLOSED
6-5	Continue filling in Section 2.2.17 – TIS-B requirements originally outlined in WP-6-13	Vince Orlando	
6-6	Outline the Appendix that describes ground processing for TIS-B	Ron Staab	
6-7	Continue filling in Appendix A.2 for TIS-B requirements originally outlined in WP-6-06	Vince Orlando	

19. The **Working Papers** shown in the following table are specifically for the Meeting being reported in these Meeting Minutes. Working Papers for all WG-3 Meetings, as well as the Meeting Agendas,

Meeting Minutes, Meeting Schedules and modifications to DO-260 for the production of Revision A, will be posted on the ADS-B 1090 MHz web site located at: <http://adsb.tc.faa.gov>

Working Paper	Size	Description	Introduced At:
1090-WP-6-01A	10KB	Proposed Note to State the current Status of TCP in DO-260A, presented by Gary Furr in response to Action Item 5-1	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-02	8KB	Proposed Changes to Tables 2-3, 2-4 and 2-5 in DO-260A, presented by Jerry Anderson	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-03	47KB	Proposal to Define 1090 MHz ADS-B Receiver Classes Requiring Enhanced Reception, presented by Jerry Anderson and Ron Jones	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-04	91KB	Draft 4 of the Enhanced Surveillance Processing Test Procedures, presented by Vince Orlando in response to Action Item 5-2	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-05	8KB	A proposed Note to Explain Why a Non-Transponder Device is Limited to Class A0, presented by Vince Orlando in response to Action Item 5-8	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-06	48KB	Draft 3 of the Proposed Material for Appendix A for TIS-B, presented by Vince Orlando	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-07	7KB	Getting Accurate [enough] UTC Time for Passive Ranging, presented by James Maynard in response to Action Item 4-16	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-08	11KB	Proposed Changes to Section 2.2 and 2.4 required by the addition of a Version Number, presented by Gary Furr in Response to Action Item 3-2	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-09	13KB	Proposed MOPS Changes to accommodate Enhanced DMTL Techniques, presented by Bill Harman in response to Action Item 4-10	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-10	13KB	Clarification of Antenna Diversity Requirements, presented by Gary Furr	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-11	39KB	Proposed Revisions to ADS-B MASPS: Integrity and Accuracy Monitoring, presented by Stuart Searight	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-12	30KB	Status Report: Simulations to obtain values of Reception Probability, presented by William Harman	Meeting 6, 08/21/2001 Honeywell, Redmond
1090-WP-6-13	36KB	Draft 1 of the TIS-B MOPS Material for Section 2.2 of DO-260A, presented by Vince Orlando in response to Action Item 5-6	Meeting 6, 08/21/2001 Honeywell, Redmond

20. As per Action Item 4-7, a review of DO-260 was accomplished and the following table of open, unresolved, or otherwise “orphaned” issues was generated. WG-3 members should review this list and ensure that there are not other issues known to them that should be on this list. This list will be reviewed at each future meeting for addition or deletion of items.

Un-resolved Issues or Questions not tracked specifically by Action Items

Issue #	Issue/Question Description	Raised by	Date Raised	Status
1	DO-260 Table 2-11 in Section 2.2.3.2.3.1, NUC _p code for Type Code=22 is still shown as TBD	Gary Furr	15 May 01	

Issue #	Issue/Question Description	Raised by	Date Raised	Status
2	DO-260 Table 2-30 in Section 2.2.3.2.6.1.13, “Turn Indicator” coding is still TBD and the implementer is directed to set the code to ZERO until further notice. If this requirement is deleted, then sections 2.2.3.2.6.2.13, 2.2.3.2.6.3.13, 2.2.3.2.6.4.13, 2.2.5.1.10, 2.2.5.1.15 and 2.2.8.1.19 must also be addressed, along with all of their section 2.4 mates. Also Appendix F, MASPS Ref #R.2.26.	Gary Furr	15 May 01	
3	DO-260 Table 2-43 in Section 2.2.3.2.7.1.4, the “TCP/TCP+1 Data Valid Subfield” was declared not to be useful during the June 2000 Plenary and the field was declared to be “reserved” and set to ZERO in the initial version of the MOPS. Section 2.4.3.2.7.1.4 only tests for the case where the code is set to ZERO. Until this field has validity, no TCP data will be considered valid! All sections relating to TCP/TCP+1 were left as written in the initial DO-260.	Gary Furr	15 May 01	A Note is being added to 2.2.3.2.7.1 to state the status of TCP in DO-260A assuming no changes.
4	Sections 2.2.3.2.7.3.3.1 through 2.2.3.2.7.3.4.4 defining both the “Capability Classes” and the “Operational Mode” of the Aircraft Operational Status Message, including Tables 2-54 through 2-61 are full of TBDs . Also affects Appendix F, MASPS Ref R2.31 and R2.32.			
5	DO-260 Table 2-67 in Section 2.2.8.1.5, the “NUC _P Coding Requirements” contains numerous TBDs .	Gary Furr	15 May 01	
6	DO-260 Table A-2 in Section A.4.1, NUC _P code for Type Code=22 is still shown as TBD	Gary Furr	15 May 01	
7	DO-260 Section A.4.9.4 was never altered after the June 2000 Plenary which declared the “TCP Data Valid” subfield to be ‘reserved’ and hard wired to ZERO in the initial DO-260.	Gary Furr	15 May 01	
8	Sections A.4.11.3 through A.4.11.10 defining the CC_4, CC_3, CC_2, CC_1, OM_4, OM_3, OM_2 and OM_1 Operational Capabilities and Statuses are full of TBDs	Gary Furr	15 May 01	
9	Appendix F, Ref. #R2.38, the effective coverage of the ground receiver is still TBD .	Gary Furr	15 May 01	
10	Implementation of the Working Papers WP-4-03 and WP-4-06 for TCAS RA, are pending a decision by the Ad Hoc MASPS Working Group on the requirement.	WG-3	15 May 01	
11	Address the issue of whether or not to write a requirement into Section 2.2 of DO-260A for using the “Conservative Error Correction Technique.”	WG-3	15 May 01	
12	Clarify the need to transmit current TCP/TCP+1. In particular the need to comply in the Test Procedures, in view of the fact that the Data Valid Flag is currently set to zero (0) in DO-260	WG-3	21 Aug 01	