

**Minutes of Meeting #7 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 17 October 2001, at the MIT Lincoln Laboratory Aviation Liaison Office in Washington DC, hosted by Dr. Orlando. Dr. Orlando welcomed all attendees, and asked that each attendee introduce themselves and their organization. The attendees included:

Jerry Anderson, FAA – AIR-130	Bill Harman, MIT Lincoln Lab	Tom Pagano, FAA TC, ACT-350
Pio Blankas, Honeywell	Ron Jones, FAA ASD-140	Stuart Searight, FAA TC – ACT-350
Mike Culver, Microsoft Corporation	James Maynard, UPS Aviation Tech.	Ron Staab, Trios Associates
Gary Furr, Titan Corp. (FAA TC - ACT-350)	Vince Orlando, MIT Lincoln Lab	John Van Dongen, FAA TC, ACT-350
Bob Granville, Consultant	Azhar Osmanbhoy, Boeing Air Traffic Mgt	

1. Following the introductions, the following known regrets to attendance were announced:
  - Greg Kuehl, UPS Airlines
  - Stacey Rowlan, L3 Communications ACSS
  - Bob Semar, United Airlines
  - Pio Blankas, Honeywell (joined us via teleconference both meeting days)
2. Following Agenda Item #2, Vince Orlando made a few introductory remarks. Dr Orlando briefed the Working Group on the just ended meeting in Paris of the SCRSP WG-B, which deals with Surveillance and ADS-B issues. WG-B was asked to produce a document commenting on the TLAT report. Dr Orlando indicated that the high points of that report deal with three main issues:
  - a. The performance of the 1090 Extended Squitter was predicated on the center-sample technique used in the Link Data Processing Unit (LDPU) produced by UPS Aviation Technologies (UPS AT). Testing at the FAA Technical Center since the TLAT report in preparation for Rev A of the 1090 MOPS has shown that better performance can be achieved.
  - b. Too much interference was used, based on the LA2020 and Core Europe scenarios evaluated by the TLAT.
  - c. In addition, SCRSP WG-A (conflict resolution) expressed concern over an ADS-B technique that could not support an air-air crosslink since this feature will likely be needed for future conflict resolution systems. The crosslink capability requires an addressed mode.

Additionally, Dr Orlando reports that rumors indicate that Eurocontrol favors specifying the 1090 Extended Squitter for air-ground usage, VDL-M4 for air-to-air usage.

Dr Orlando reported that SC-187 has been reactivated in order to produce an amendment to DO-181C (if required) to not allow transponders to be shut down while airborne. Following Agenda Item #3, the Working Group reviewed the proposed Agenda and made decisions as to which Working Papers should be taken up under a specific Agenda Item. The result of this was a revised Agenda (011017-Agenda-A), which will be posted on the 1090 Web Site after the meeting.

3. Following Agenda Item #4, the Working Group reviewed the Minutes of Meeting #6 held at the Honeywell Learning Facility in Redmond Washington. Hearing no objection or further comment, the Minutes of Meeting #6 were approved as published.
4. Following Agenda Item #5, the Working Group reviewed the locations, dates and times of the next meetings, which were scheduled. 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
Monday, December 3 at 9am through 5pm, Thursday, 6 December	Confirmed at 1 Kemble Street, central London, hosted by NATS Lodging suggested at Drury Lane Moat House Hotel +44-845-910-2030 Lodging information and maps have been distributed to members.
Wednesday, 9 January at 9am through 5pm, Friday, 11 January 2002	Confirmed at Best Western Oceanside Inn, 1180 Seabreeze Blvd (A1A), Ft. Lauderdale, FL, hosted by MIT. 10 rooms set aside by MIT at \$110 More Lodging and travel information will be made available soon.
Tuesday, 12 February at 9am through 5pm, Wednesday, 13 February	Confirmed in Phoenix AZ, hosted by L3 Communications Actual meeting location <b>TBD</b> Lodging and travel information will be made available soon.
Tuesday, 26 March at 9am through 5pm, Thursday, 28 March	Meeting location at the FAA Tech Center, Atlantic City, NJ  Travel info and lodging details are available on the ADS-B/1090 web site
Tuesday, 23 April at 9am through 5pm, Thursday, 25 April	Meeting location at the FAA Tech Center, Atlantic City, NJ  Travel info and lodging details are available on the ADS-B/1090 web site
Tuesday, 18 June at 9am through 5pm, Friday, 21 June	Tentatively planned for June 18 and 19 at MIT/Lincoln Laboratory Aviation Liaison Office prior to SC-186 Plenary that is tentatively scheduled for 20-21 June at RTCA

5. Following Agenda Item #6, the Working Group asked Stuart Searight and James Maynard to briefly describe the current status of the changes to the ADS-B MASPS being considered by SC-186 Working Group 6. Stuart and James report that a new issue has been raised by Rannoch regarding surface movement and the squitter rate while “on-the-ground.” Rannoch wants 1090ES to broadcast at the high rate all of the time. The Working Group reviewed section 2.2.3.3.2.3 of DO-260, which deals with the Surface Position Message Broadcast Rate and found that the parameters on which a broadcast rate changes from high to low rate shows that the position has not changed more than 10 meters over a 30 second sampling interval. Likewise, in order to change from the low to high rate of broadcast, the position must change more than 10 meters from the aircraft position when the low rate was invoked. Following discussion of possible changes in position because of GPS drift, the Working Group agreed to analyze whether or not it was reasonable to lower the distance from 10 meters to some lower value based on the fact that SA has been removed from the GPS.

Other MASPS changes continue to affect DO-260A are those related to the TCPs. Stuart and James report that it is likely that no changes will be made to the requirements section of DO-242A with respect to TCPs, therefore no major changes will be required to DO-260A.

Changes to NUC/NIC/NAC/SIL as proposed to DO-242A will affect major sections of DO-260A. James Maynard had previously accepted **Action Item 5-6** to revise WP-5-10A with the latest known information regarding NIC/NAC/SIL and re-present a Working Paper at Meeting #8 showing changes to DO-260 as a result of implementation of the NIC/NAC/SIL in DO-242A.

Pursuant to the discussions on NIC/NAC/SIL, the Working Group began to discuss proposed changes to the State Vector, Mode Status and TCP+1 Reports with regard to changes proposed to DO-242A. After lengthy discussion, it was agreed that any changes to the structure of these Reports would result in a major modification to DO-260, potentially resulting in several months worth of document

revision, editing and proof reading. The Working Group agreed that no changes be made to the structure of any of the Reports.

During discussion, it was brought out that some of the proposed MASPS changes would not be compatible with the existing MASPS – i.e., equipment built to conform to the existing MASPS/MOPS would have to be changed. Jerry Anderson strongly advocated backward compatibility, and most other Working Group members agreed with him. It was pointed out that backward compatibility is always important, but particularly so when making an amendment to a standards document, developed just a few years ago.

The Working Group agrees that it continues to be difficult to coordinate our work with the impending MASPS changes. SC-186 appears to have scheduled the formal adoption of the changes for DO-242A on 8-12 April 02. SC-186 has one meeting prior to that (12-13 December 2001), and we believe that WG-6 has planned a clean presentation of the final proposed MASPS changes at that time. But, it has been made clear to us that the actual changes will not be known until the SC-186 April 2002 meeting.

With this in mind, WG-3 is currently planning for the 1090 MOPS completion for adoption at the SC-186 meeting on 19-21 June 2002. To allow for balloting, we must deliver the final document to RTCA a month before that, which allows us only one meeting to react to the actual MASPS changes. This does not allow time to change the 1090 MOPS in response to unexpected MASPS changes in April. Probably what we will do is conform the 1090 MOPS only to MASPS changes that are nearly certain: including NIC/NAC/SIL and maybe nothing else. Also we are hoping that WG-3 members will attend the meeting of SC-186 in December to call attention to the problems and to encourage SC-186 to keep the MASPS changes stable and predictable.

6. The Working Group agreed to jump to Agenda Item 11 for the presentation of Working Paper WP-7-04 by Mike Culver of Microsoft. Mike proposes separating data from the underlying transport protocol in order to make data delivery extensible and standards-based. In addition, he proposes adopting XML as a data format, while recognizing there are implementation issues (addressable) that need careful attention in order to make XML function in a multicast data environment, as well as recognizing that there will be a performance degradation.
7. Next, the Working Group moved to Agenda Item 9 and began with the review of Working Paper WP-7-02 by Vince Orlando. Vince reviewed the 4<sup>th</sup> draft of the changes to Appendix A as a result of including TIS-B Formats and Coding. Vince agreed to accept **Action Item 7-11** to continue completing sections of A.2, specifically in the Management Message Sections, for the next meeting.
8. Vince Orlando continued with the review of Working Paper WP-7-01, which had not been significantly updated since the review at the last meeting. WP-7-01 was not distributed prior to the meeting in the standard ZIP file, therefore, it was agreed that Gary would distribute WP-7-01 separately after the meeting and ask that all members review the proposed changes to Section 2.2 as a result of including TIS-B, and comment prior to the London Meeting. Vince Orlando also accepted **Action Item 7-10** to continue updating section 2.2.17 and to start drafting section 2.4.17 for the London Meeting.
9. Continuing with Agenda Item 9, the Working Group began review of Working Paper WP-7-07, presented by Ronald Staab as an initial draft of a proposed Appendix to deal with Ground Processing for TIS-B and FIS-B. As an initial discussion point, Ronald presented WP-7-07 as the requirements for the Ground Broadcast Services (GBS) to be implemented at the Memphis International Airport for the Cargo Airline Association/SafeFlight 21 Operational Evaluation 3. After a brief Working group discussion on the topic, Vince Orlando agreed to accept **Action Item 7-3** to outline the

requirements for this proposed Appendix for Ground Processing for TIS-B. No further review of WP-7-07 was taken.

10. Jumping back to Agenda Item 11, the Working group began review of Working Paper WP-6-03, which had been deferred from Meeting #6 because the author, Ron Jones, was unable to attend and present the Paper. Ron Jones briefed the Working Group for the reasons behind the proposals suggested in WP-6-03 for modifications to DO-260. Ron indicated that analysis of the data collected by the FAA during evaluations of 1090 MHz Extended Squitters in Los Angeles and Frankfurt, Germany clearly indicate that the effective range of the 1090 MHz ADS-B systems can be significantly reduced by the presence of very high levels of Mode A/C fruit. It is clear from both measurement results and from modeling of the 1090 MHz ADS-B system that enhanced reception methods, providing performance at least similar to that afforded by the enhanced decoding technique detailed in Appendix I of DO-260A, will be necessary in order for the 1090 MHz ADS-B system to fully satisfy the DO-242 requirements. Therefore, it is proposed to amend the draft DO-260A to include a means of designating, for purposes of certification, those avionics that incorporate 1090 MHz receivers that employ reception techniques that have the performance required by the enhanced reception test procedures of DO-260A. This change will facilitate the certification of 1090 MHz ADS-B avionics for supporting such application as Separation Assurance and Sequencing even in the highest traffic density and highest 1090 MHz Mode A/C fruit environments. After discussion, the Working Group agreed to accept the proposal set forth in Working Paper WP-6-03 to make changes to Table 2-5 to define enhanced classes of 1090 MHz ADS-B receivers and to note the limitations of the receivers that do not incorporate the enhanced reception techniques to be outlined in subparagraph 2.2.4.4. Gary Furr will implement those suggested changes and will post on the 1090 web site a copy of the revised Table 2-5.
11. Continuing with Agenda Item 11, the Working Group began review of Working Paper WP-6-02, which had been deferred from Meeting #6 because the author, Jerry Anderson, was unable to attend and present the paper. Jerry Anderson briefed the Working Group for the reasons behind the proposals suggested in WP-6-02 for modifications to Tables 2-3, 2-4 and 2-5 in DO-260. The Working Group also discussed how current considerations within Working Group 6 might also alter Tables 2-3, 2-4 and 2-5 with regard to the State Vector, Mode Status and TCP or “On-Condition” Reports, which might be changed with the acceptance of DO-242A. After discussion, the Working Group agreed to accept the proposed changes outlined in WP-6-02 to each Table and to have Gary Furr implement those changes and post modified Tables on the 1090 web site. Additionally, Gary will add an entry in the “Orphan Issues List” shown below to indicate that additional changes will need to be made to these tables if SC-186 approves changes suggested by WG-6 to DO-242A to eliminate the Partial Mode Status Report (MS-P), only produce a standard MS Report, and to put all TCP information into a newly defined “On-Condition” Report.
12. In conjunction with Agenda Item 7, Gary Furr began review of Working Paper WP-7-03, which served to review all of the potential changes to DO-260A because of the implementation of the Version Number as agreed to by the Working Group during Meeting #3. During review of WP-7-03, the Working Group decided that the proposed changes for section 2.2.5.1.44 were not acceptable and that the proposed changes should be modified to indicate that in versions of transmitting devices that are compliant with DO-260A, the Version Number should be set to one (1). Section 2.4.5.1.44 would also be changed to reflect this suggestion. During discussion of the proposed changes to Table 2-71a with the addition of a Version Number presence bit, it was finally agreed by the Working Group that this “Presence Bit” was required and should remain as proposed in WP-7-03. After other suggested changes to proposed Test Procedures in WP-7-03, it was agreed that this Working Paper would be revised and offered again for review at Meeting 8.

13. Continuing with Agenda Item 7, Working Paper 7-09 was reviewed by the Working Group as presented by Stacey Rowlan, to suggest changes to Sections 2.2 and 2.4 to eliminate Range Based Decoding references and requirements. Stacey concludes that the task of eliminating references to Range Monitoring can be accomplished by deleting subparagraphs 2.2.8.4.1, 2.2.8.4.2, 2.4.8.4.1 and 2.4.8.4.2. The Working Group discussed these changes and **agreed** that they should be implemented. Gary Furr will make the changes and post a file on the 1090 web site showing the resultant text (or lack thereof).
14. Starting with Agenda Item 7, Vince Orlando began with the review of WP-7-05, as Draft 5 of the Test Procedures for Enhanced Surveillance. Vince indicated that few changes had been made since Draft 4, with only the deletion of a few of the word “shall” in text of the test procedures. Now, the only places where the word “shall” appear in these test procedures is in the place where the test equipment is specified. Vince accepted **Action Item 7-4** to make continuing changes to these test procedures and present those specified in the Action Item at the next meeting.
15. Continuing with Agenda Item 7, John Van Dongen presented WP-7-06. The FAA Technical Center (ACT-350) has conducted the Enhanced Surveillance Processing Test Procedures as defined in 2.4.4.4 (1090-WP-6-04) utilizing the RF Measurement Facility and the associated enhanced reception implementations. John indicates that WP-7-06 contains the results of these tests as assigned by Action Item 5-7 to be used as input to provide the required performance for the enhanced surveillance processing techniques in 2.4.4.4. John agreed to prepare a short briefing to be used with this Working Paper for presentation for the London meeting.
16. Finishing with Agenda Item 7, Bill Harman presented Working Paper WP-7-08 detailing the simulation of MOPS bench tests. Bill indicates that MIT Lincoln Laboratory is using two techniques to come to an agreement on specific values to use in the draft performance requirements for the minimum reception probabilities. One technique is based on simulation and the other based on bench tests. WP-7-08 presents recent simulation results and describes the current stats and plans for further work.
17. 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.

### RTCA SC-186 Working Group 3 Open Action Items after Meeting #7

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.	Vince Orlando	
2-17	Review the NL equation at A.7.2.d and possibly reword for latitudes at 87.	Jim Maynard	
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 Jeziarski	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 #8	James Maynard	

Action Number	Action Description	Assigned to	Status
7-1	Provide a report on FIS-B weather encoding to Mike Culver	Bill Harman	
7-2	Estimate the data rate required for current versus XML encoding	Mike Culver	
7-3	Outline requirements for the Appendix for Ground Processing for TIS-B	Vince Orlando	
7-4	Make changes to the Test Procedures which were detailed in WP-7-05 to (1) allow a 5-bit message Type field, (2) add the alternative for a 32-bit CRC for undetected errors, (3) change relative value of overlapping Mode S fruit to -2, -4, -6 and -8 dB.	Vince Orlando	
7-5	Make changes discussed during review of WP-7-03 for all changes in 2.2 and 2.4 caused by the insertion of the Version Number field.	Gary Furr	To be addressed by <b>WP-8-02</b>
7-6	Make changes to Appendix A for changing all DO-260 subparagraphs to A.1, since TIS-B is going to be inserted as A.2. This also includes making changes to the entirety of DO-260 to change all references to Appendix A subparagraphs.	Gary Furr	
7-7	Compare false alarm rate for 10m transition to high-rate for surface broadcast with SA to smaller distance value to achieve the same false alarm rate without SA	Bill Harman	
7-8	Investigate the asymmetrical performance of the Gold Standard and Multi-Sample implementations	John Van Dongen	
7-9	Investigate the underlying mechanism of the reception performance curves	Bill Harman	
7-10	Continue filling in Section 2.2.17 and 2.4.17– TIS-B requirements outlined in WP-7-01	Vince Orlando	To be addressed by <b>WP-8-01</b>
7-11	Continue filling in Appendix A.2 for TIS-B requirements outlined in WP-7-02	Vince Orlando	

18. 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-7-01	37KB	Draft 2 of TIS-B MOPS Materials for Section 2.2.17, presented by Vince Orlando in response to Action Item 6-5	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-02	52KB	Draft 4 of the Appendix Material for 1090 TIS Broadcast, presented by Vince Orlando in response to Action Item 6-7	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-03	89KB	Implementation of agreed upon changes to Sections 2.2, 2.4 and Appendix A as a result of the implementation of a Version Number, as presented by Gary Furr	Meeting 7, 10/17/2001 MIT-LL Liaison – DC

Working Paper	Size	Description	Introduced At:
1090-WP-7-04	20KB	Separating Data From The Transport – In Support of FIS-B Services, presented by Mike Culver of Microsoft Corporation	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-05	51KB	Draft 5 of the Enhanced Surveillance Processing Test Procedures, presented by Vince Orlando in response to Action Item 6-3	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-06	52KB	Extended Squitter Interference Test Data, presented by John Van Dongen in response to Action Item 5-7	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-07	73KB	Draft 1 of a Proposed Appendix for Ground Processing for TIS-B and FIS-B, presented by Ronald Staab	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-08	45KB	Simulation of MOPS Bench Tests, presented by William Harman	Meeting 7, 10/17/2001 MIT-LL Liaison – DC
1090-WP-7-09	11KB	Proposal to Eliminate Range-Based Decoding Requirements, presented by Stacey Rowlan in response to Action Item 4-4	Meeting 7, 10/17/2001 MIT-LL Liaison – DC

19. As per Action Item 4-7, a review of DO-260 was accomplished and the following table of open, or unresolved, issues was generated, along with two issues defined during Meeting #4. 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 review at each future meeting for addition or deletion of 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 <sub>p</sub> code for Type Code=22 is still shown as <b>TBD</b>	Gary Furr	15 May 01	
2	DO-260 Table 2-30 in Section 2.2.3.2.6.1.13, “Turn Indicator” coding is still <b>TBD</b> and the implementer is directed to set the code to <b>ZERO</b> 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 <b>ZERO</b> 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 <b>ZERO</b> . 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.

Issue #	Issue/Question Description	Raised by	Date Raised	Status
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 <b>TBDs</b> . 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 <sub>P</sub> Coding Requirements” contains numerous <b>TBDs</b> .	Gary Furr	15 May 01	
6	DO-260 Table A-2 in Section A.4.1, NUC <sub>P</sub> code for Type Code=22 is still shown as <b>TBD</b>	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 <b>TBDs</b>	Gary Furr	15 May 01	
9	Appendix F, Ref. #R2.38, the effective coverage of the ground receiver is still <b>TBD</b> .	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	
13	Additional changes will need to be made to Tables 2-3, 2-4 and 2-5, and potentially other places in DO-260, if SC-186 approves changes suggested by WG-6 to DO-242A to eliminate the Partial Mode Status Report (MS-P), only produce a standard MS Report, and to put all TCP information into a newly defined “On-Condition” Report.	WG-3	18 Oct 01	