Minutes of Meeting 3 of SC-186 Working Group 3
Development of MOPS for 1090 MHz ADS-B, Revision A

The meeting was called to order by Dr Vince Orlando at 9am on 20 March 2001, at the Embassy Suites Hotel, hosted by L-3 Communications. Dr. Orlando welcomed all attendees, gave some introductory remarks, and asked that each attendee introduce themselves and their organization. The attendees included:

Jerry Anderson, FAA – AIR-130	James Maynard, UPS Aviation Tech.	Ken Staub, Trios Associates
Pio Blankas, Honeywell	Vince Orlando, MIT Lincoln Lab	Cyro Stone, L3 Communications
Gary Furr, Titan Corp. (FAA TC - ACT-350)	Stacey Rowlan, L3 Communications	John Van Dongen, FAA TC – ACT-350
Carl Jezierski, FAA TC – ACT-350	Stuart Searight, FAA TC – ACT-350	Gene Wong, FAA – AND-530
Greg Kuehl, UPS Airlines	Bob Semar, United Airlines	

1. Following the introductions, the following known regrets to attendance were announced:
   - R.H. "Bob" Saffell is busy putting out other corporate fires.
   - Ron Jones was not able to be here because of other commitments.
   - Bill Harman could not join us because of family illness.

2. At the Melbourne meeting #2, the Working Group agreed to add a Version Number subfield to the Aircraft Operational Status Message. The purpose of this subfield is to define the Version Number of the formats and protocols in use by the transmitting device. A version number is required because it is expected that the formats and protocols will evolve with time and more than one version may be in use during a transition period. The receiver uses the Version Number in order to correctly process ADS-B messages. Vince Orlando presented Working Paper WP-3-01 as a proposal to insert the Version Number subfield into bits 41 through 44 of the Aircraft Operational Status Message. A proposed subparagraph was presented for insertion into Appendix A, at A.4.11.11, with a corresponding revision of Figure A-12. After discussion, the proposed Table A-21 was revised from the original submission of 1090-WP-3-01 to indicate that a Version Number coding of one (1) indicated conformance to DO-260A. During discussions, **Action Item 3-1** was accepted by James Maynard to Check DO-260 to understand if the Status Message is a requirement for all installations for all equipage classes. Additionally, **Action Item 3-2** was accepted by Gary Furr to report on all of the necessary changes to DO-260 required to fully incorporate the changes suggested by WP-3-01.

3. At the Melbourne meeting #2, the Working Group agreed to identify a means for making the contents of the TCAS air-ground Resolution Advisory (RA) downlink message (contained in aircraft register 30 Hex) available as an extended squitter broadcast. Vince Orlando presented Working Paper WP-3-02 as a possible approach for squittering this information via the Extended Squitter Aircraft Status Message. The format for this message contains a three-bit Subtype Code subfield. At present, only Subtype Code = 1 is defined. It identifies the Emergency/Priority Status Message as indicated in DO-260 and WP-3-02 as Figure A-9. Vince proposes that Subtype Code = 2 for this message type be defined for the TCAS RA Broadcast as indicated in WP-3-02, Figure A-9A. In operation, the General Format Manager (GFM) would monitor 30 Hex, the aircraft register used for air-ground transfer of the TCAS RA downlink. When data is inserted in register 30, that same information would be inserted into the TCAS RA broadcast squitter.

   It was agreed during discussions that this issue needs to be taken up with the Ad Hoc MASPS revision Working Group at their next meeting to see if the suggestions proposed by Vince in this Working Paper should become a requirement. Vince Orlando accepted **Action Item 3-3**, indicating that he will continue work on implementing the details of this proposal in modifications to Appendix A, Sections 2.2 and 2.4.

4. At the Melbourne meeting, Ian Levitt raised a question on how to implement the conservative error correction technique. The specific issue was whether the process could stop when a correctable pattern was found, or must the processes continue to determine if the correctable pattern was unique. Vince Orlando presented Working Paper WP-3-03 suggesting that the answer to the question is that there is at most one correctable error correction pattern possible with the conservative error technique. Therefore the process can stop if this unique solution is found. Vince indicated that he had talked to Ian and he agreed with this conclusion. Ian recommended that a more detailed definition of this technique be included in the MOPS. Working Paper 3-03 also provides a brief overview of conservative error correction in order to support the above conclusion. Vince Orlando accepted **Action Item 3-4** to add materials to Appendix I to more fully explain the Conservative Error correction technique. Vince also stated that he believes that DO-260A should require the Conservative Error Correction technique. Conversely, we could also say that the sliding window technique should not be used. Some minor corrections were also made to WP-3-03 and a revised Working Paper will be posted on the 1090 web site as WP-3-03A.

5. Greg Kuehl of UPS Airlines presented Working Paper 3-04 indicating his proposed changes to DO-260, Section 3, resulting from an implementation of previously approved revisions to Tables 2-54 and A-13, the encoding of the "CC_4" subfield in the Aircraft Operational Status Message. Following discussions on Greg's proposals, Greg accepted **Action Item 3-5** to research further places in DO-260 where references might exist for using a 1090 non-transponder device together with a Mode-S device. Greg will propose text to prohibit that operational configuration. Greg also accepted **Action Item 3-6** to prepare revisions to his proposed text of Section 3 to incorporate suggestions during discussions and present the revisions at the next meeting.

6. Working Paper WP-2-04, dated 30 January 2001, proposed modifications to DO-260 Section 2.2.3.3.2.4 by adding subparagraph "b" to add the requirement to use the Event Driven Protocol to broadcast an additional Aircraft Identification and Type Message when the TCP, TCP+1 and Aircraft Operational Status Messages are being utilized. Bob Saffell prepared Working Paper 3-10 to provide the necessary test procedure modifications to Section 2.4.3.3.2.4 needed to address those changes approved with WP-2-04. Since Bob was not able to attend Meeting #3, he added some concerns at the end of WP-3-10. During discussion of those concerns, it was agreed by the Working Group that changes to the test procedure would be appropriate. The text of the changes was discussed with Bob Saffell after the meeting and Bob agrees with the changes. Therefore, WP-3-10 was changed as agreed by WG-3, and will be posted on the 1090 web site as WP-3-10A. These changes will be incorporated into DO-260A along with those proposed in WP-2-04.

7. It was previously agreed by WG-3 to make certain changes to the track state transition standards identified in Section 2.2.10 from 25 seconds to 120 seconds. Corresponding changes were then required, identified and accepted for Figures 2-16b and 2-16c, which illustrated that change. A corresponding change to Figure 2-16a was required to be consistent with the other two Figures. Bill Harman preparedWP-3-13 as a change to Figure 2-16a. The change to Figure 2-16a brought up some questions during discussion of WG-3 related to the applicability of the note added to Figure 2-16a as to whether it related to the 120 second period or the 250 second period. It was agreed to alter the submitted Figure 2-16a to make it clearer. Stuart Searight made modifications to the submitted Figure 2-16a and the changes were approved by WG-3. The changes identified for Figures 2-16a, 2-16b and 2-16c will be carried forward and become part of DO-260A. The modification of WP-3-13 will be posted on the 1090 web site as WP-3-13A.

8. Working Paper WP-2-01 recommended that the coast time allowed before requiring a global decode be increased from 25 seconds to 120 seconds, and this position was approved by the Working Group.

However, during Meeting #2, it was discussed that Section A.7.8 describes two methods for performing local CPR decoding, the Range Monitoring and Emitter Centered methods. It was agreed that while both methods can be used to provide unambiguous decode of position, a limitation with the Range Monitoring method should be considered. In response to Action Item 2-1, Stacey Rowlan presented Working Paper WP-3-11 after a review of Section A.7.8. Stacey recommended that IF the Emitter Centered method is to be required, then the description of the Range Monitoring method either be deleted from Section A.7.8, and its subsections, OR, the Range Monitoring method should be clearly noted as being supplied for background information and does not meet the requirements of the MOPS. Stacey also recommended that Section A.7.4 be changed to indicate that the reference point is the last track position of the intruder. After Group discussion, Stacey accepted **Action Item 3-7** to discuss with Bob Saffell the approach to be used for extended coast time relative to the Range Monitoring method.

9. During Meeting #2, Working Paper WP-2-11 identified comments for improvement of the clarification of the 1090 MOPS Appendix I. Comment #10 of WP-2-11 raised a question on the signal level to be used in the preamble retriggering process. Vince Orlando presented Working Paper WP-3-05 in response to Action Item 2-11. Vince confirms what had been discussed in Meeting #2 with regard to Comment #10 in WP-2-11 and the Working Group approved changing the word "declared" to "reference" in the 2nd paragraph, third line of subparagraph I.4.1.2.3. The change will be made for DO-260A and will be posted on the 1090 web site as one of the changes approved for Appendix I.

10. In support of Action Item 2-12, John Van Dongen presented Working Paper WP-3-07 to propose changes to add material to Appendix I to describe the technique for developing multisampling matrices for sampling rates higher than 8 MHz. After Group discussion, the changes that were proposed by John were accepted by the Working Group. The additions to Sections I.4.2.3 and I.4.2.4 suggested in WP-3-07 will be made for DO-260A and will be posted on the 1090 web site as one of the changes approved for Appendix I. John Van Dongen accepted **Action Item 3-8** to examine the conditions for declaring the preamble in reference to lead edge position.

11. In response to Action Item 2-13, John Van Dongen analyzed the reply reception probability for alternative matrices, if the conservative error correction technique is the only error correction method applied. John determined that the data presented at WG-3 Meeting #2 included utilization of the sliding window error correction technique. The data contained as presented in Working Paper WP-3-09 shows the original data as well as the matrix comparisons using only the conservative technique, and the conservative and brute force techniques. John concluded that the data shows that most of the alternative table performance increase with the RMF implementation is achieved only when using the sliding window error correction technique. There is some performance increase when using only conservative and brute force, but the performance in this case still varies from target to target. John suggests that his data does not support changing the matrix suggested in Appendix I. However, since implementation of the odd/even technique may vary in many ways, developers should not be precluded from testing alternative matrices.

12. A new version of the 1090 Radio Frequency Measurement (RMF) "Gold Standard" Enhanced Reception program has been developed that emulates reception limitations of a real-time application. John Van Dongen presented Working Paper WP-3-08 as the software description, to include details of the real-time design approach. After presentation of the Working Paper and Group discussion, John accepted **Action Item 3-9** to look into the use of DMTL in preamble validation.

13. In response to Action Item 2-15, and in the absence of Bill Harman, Vince Orlando presented Working Paper WP-3-14. There was a suggestion from Meeting #2 to perform receiver testing for multiple interferers at a common power level rather than more numerous tests at different power

levels. WP-3-14 analyzes this in more detail. Receiver bench test measurements were analyzed to compare average reception probability for a simpler test relative to a more complex test. The results presented in WP-3-14 suggest that the average reception probability is nearly the same regardless of whether the multiple ATCRBS interferers are all at the same power level or are distributed in power. This supports the original idea that it may be sufficient to define specific requirements/tests using multiple interferers at a common power level, rather than a much larger number of tests covering multiple combinations of power levels. After significant Group discussion, it was agreed by the Working Group to have two (2) tests at two (2) different power levels, one (1) with fruit at different levels, and one (1) with fruit at the same level. It was agreed to run the tests seven (7) times with seven (7) cases, and to compute the average.

14. A principal focus of the effort to produce Revision A of the 1090 MHz MOPS is the addition of test procedures for the enhanced surveillance processing techniques. Vince Orlando presented Working Paper WP-3-06 as an approach to starting the test procedures, which have been discussed at both previous meeting of WG-3. Vince proposed to break the test procedures down into two primary test categories: (a) Preamble Detection Tests, and (b) Data Block Tests. WP-3-06 only contained material on the "Data Block Tests" with ATCRBS fruit. Action Item 3-12 was accepted by Stacey Rowan to develop the preamble test procedures for Meeting #4. **Action Item 3-13** was accepted by Vince Orlando to continue with revisions and the addition of the test procedures for Mode S fruit to WP-3-06 for presentation at Meeting #4. **Action Item 3-14** was accepted by John Van Dongen to work with Bill Harman to consider the need to run cases with 2, 3 and 4 fruit, since we are already running tests with 0, 1 and 5. **Action Item 3-15** was accepted by Gary Furr to work with Stuart Searight, John Van Dongen and Bob Saffell to determine where in Sections 2.2, and 2.4 of DO-260A placement should be made for requirements and tests related to (a) enhanced processing, (b) TIS-B, and (c) FIS-B.

15. At the request of WG-3, James Maynard made a presentation of Working Paper WP-3-12 which is a revision of a document that James had presented to the Ad Hoc Working Group for the revision of DO-242, the ADS-B MASPS, on the topic of making changes to the State Vector (SV) Report for the purpose of accommodating the revisions to the replacement of the NUC codes with NIC and NAC codes. Following considerable discussion within the Group over the proposed changes to the SV and the addition of NIC/NAC codes, it became clear that there was considerable concern over the source of the NIC/NAC values, and exactly how the containment radii and/or HPL are derived. Stacey Rowlan and Cyro Stone were requested by WG-3 to discuss these concerns with other manufacturers and draft a formal statement to be conveyed to Working Group #4.

16. 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 remain OPEN, and/or were just closed in this meeting as a result of Working Papers or other actions being reported on in these Meeting Minutes.

Action Number	Action Description	Assigned to	Status
1-1	Review the test procedures in DO-181B and DO-260 with respect to "FS" and "VS" and make a recommendation for changes to either document.	Tom Pagano	Will be deferred to later meeting
1-7	Compare performance of their non real-time test sets.	MIT/FAATC	Deferred to later meeting
2-1	Reviewing section A.7.8 and compare to equations agreed to by the Ad Hoc CPR Committee prior to the publication of DO-260	Stacey Rowlan	Addressed by WP-3-11 **CLOSED**

Action Number	Action Description	Assigned to	Status
2-2	Review Figure 2-16a to compare with changes made to Figures 2-16b and 2-16c	Bill Harman	Addressed by WP-3-13 **CLOSED**
2-3	Review changes to 2.2.3.3.2.4 identified in WP-2-04 for needed changes to 2.4.3.3.2.4. *Modifications made during Meeting #3 were approved by Bob Saffell after the meeting.*	Bob Saffell	Addressed by WP-3-10 with modifications **CLOSED**
2-4	Begin outline of a new Appendix (M) for DO-260 to address techniques for improved reception range.	Ron Jones	
2-5	Propose a MOPS version field in the status message	Vince Orlando	Addressed by WP-3-01 **CLOSED**
2-6	Draft a TCAS active resolution advisory broadcast for 1090 MHz.	Vince Orlando	Addressed by WP-3-02 **CLOSED**
2-7	Discuss with Bob Hilb the reason for the active resolution broadcast.	Greg Kuehl	**CLOSED**
2-8	Revisit WP-2-13 and expand with explanatory text. Get all text to Gary Furr for rolling into a proposed change to DO-260	Greg Kuehl (*) Gary Furr	Addressed by WP-3-04 **CLOSED**
2-9	How do you implement the Brute Force technique?	Stacey Rowlan (*) Bob Saffell	
2-10	Resolve the conservative error correction relative to all combinations of flipping of low confidence bits and not just the first successful event.	Ian Levitt / MIT	Addressed by WP-3-03 **CLOSED**
2-11	Verify that change made to comment #10 of WP-2-11 is correct.	Vince Orlando	Addressed by WP-3-05 **CLOSED**
2-12	Add material to Appendix I to describe the technique for developing multisampling matrices for sampling rates higher than 8MHz	John Van Dongen	Addressed by WP-3-07 **CLOSED**
2-13	Analyze data from WP-2-14 to consider reply reception probability for the alternate matrix if conservative is the only error correction technique applied.	John Van Dongen	Addressed by WP-3-09 **CLOSED**
2-14	Develop a representative test of the enhanced processing techniques.	Vince Orlando	Addressed by WP-3-06 **CLOSED**
2-15	Extended Squitter Bench Test specifications. Compute averages of bench test data.	Bill Harman	Addressed by WP-3-14 **CLOSED**
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	
3-1	Check DO-260 to understand if the Status Message is a requirement for all installations for all equipage classes.	Jim Maynard	

Action Number	Action Description	Assigned to	Status
3-2	Report on all of the necessary changes to DO-260 to fully incorporate the changes suggested by WP-3-01, with the proposed Version Number Subfield.	Gary Furr	
3-3	Propose changes to Appendix A to incorporate the TCAS RA Broadcast on 1090 MHz.	Vince Orlando	
3-4	Add material to Appendix I to more fully explain the Conservative Error correction technique.	Vince Orlando	
3-5	Research places in DO-260 where references exist for using a 1090 non-transponder device, together with a Mode-S device. Proposed text to prohibit that operational configuration.	Greg Kuehl (*) Vince Orlando	
3-6	Prepare revisions to WP-3-04 as discussed during Meeting #3.	Greg Kuehl	
3-7	Check with Bob Saffell on the approach to be used for extended coast time relative to the range method.	Stacey Rowlan	
3-8	Examine the conditions for declaring the preamble in reference to lead edge position.	John Van Dongen	
3-9	Look into the use of DMTL in preamble validation	Bill Harman	
3-10	Put together all of the text for Appendix A for TIS-B	Vince Orlando	
3-11	Update on FIS-B encoding	Vince Orlando	
3-12	Write a preamble detection test	Stacey Rowlan	
3-13	Revise WP-3-06 (Draft Test Procedures for Enhanced Surveillance)	Vince Orlando Bill Harman	
3-14	Consider the need to run cases with 2, 3 and 4 fruit, since we are already running tests with 0, 1 and 5	Bill Harman John Van Dongen	
3-15	Review sections 2.2 and 2.4 to determine where to place paragraph requirements for enhanced processing, TIS-B and FIS-B	Gary Furr Stuart Searight John Van Dongen Bob Saffell	
3-16	Show how the newly proposed MASPS requirements outlined in WP-3-12 can be incorporated into DO-260A	James Maynard	

17. 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

SC-186 Working Group 3 – 1090 MOPS, Rev A – Working Papers

Working Paper	Size	Description	Introduced At:
SC186/WG3-WP-3-01	15KB	1090 MHz ADS-B Format and Protocol Version Number, presented by Vince Orlando in support of Action Item 2-5	Meeting 3, 03/20/01 Phoenix, AZ

Working Paper	Size	Description	Introduced At:
SC186/WG3-WP-3-02	19KB	1090 MHz ADS-B TCAS Resolution Advisory - Broadcast, presented by Vince Orlando in support of Action Item 2-6	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-03	13KB	Clarification of Conservative Error Correction, presented by Vince Orlando in support of Action Item 2-10.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-04	20KB	Further discussion of TCAS RA and proposed changes to Section 3, presented by Greg Kuehl in support of Action Item 2-8.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-05	9KB	Clarification and verification of preamble triggering referenced in Comment #10 of WP-2-11, presented by Vince Orlando in support of Action Item 2-11.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-06	22KB	Initial draft of the Enhanced Surveillance Processing Test Procedures, presented by Vince Orlando in support of Action Item 2-14.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-07	10KB	Proposed changes to Appendix I to facilitate Action Item 2-12 to add material to describe the technique for developing multisampling matrices for sampling rates higher than 8 MHz, presented by John Van Dongen.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-08	36KB	Revised version of the 1090 RMF “Gold Standard” Enhanced Reception software program, presented by John Van Dongen.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-09	27KB	Response to Action Item 2-13 to analyze reply reception probability for alternative matrices if the conservative error correction technique is the only error correction method applied, presented by John Van Dongen.	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-10	12KB	Response to Action Item 2-3 to propose changes to Test Procedures in Section 2.4.3.3.2.4 for changes approved in WP-2-04, presented by R.H. “Bob” Saffell	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-11	8KB	A review of A.7.8 presented by Stacey Rowlan in support of Action Item 2-1	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-12	165KB	Suggested modifications of the State Vector (SV) with respect to NIC/NAC/NUC, presented by James Maynard	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-13	9KB	Revision of Figure 2-16a to match similar changes made to Figures 2-16b and 2-16c related to changes to the track-state transition standards, presented by Bill Harman in support of Action Item 2-2	Meeting 3, 03/20/01 Phoenix, AZ
SC186/WG3-WP-3-14	14KB	Receiver testing for multiple interferers at a common power level rather than more numerous tests at different power levels, Presented by Bill Harman in support of Action Item 2-15.	Meeting 3, 03/20/01 Phoenix, AZ

18. The following table indicates the 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**
Tuesday, May 15 at 9am through 5pm, Thursday, May 17	Confirmed at MIT/Lincoln Laboratory Aviation Liaison Office The Portals Building 1280 Maryland Ave., SW, Suite 250, Washington, DC (202) 646-0400
Tuesday, July 10 at 9am through 5pm Thursday, July 12	Confirmed at FAA Technical Center, Atlantic City International Airport (Secure facility, prior registration is required.) Email or call Gary Furr 609-485-4254 to verify attendance See the 1090 web site for detailed travel maps and lodging information
Tuesday, August 21 at 9am through 5pm, Thursday, Aug 23	Confirmed at Redmond Washington, hosted by Honeywell at the Honeywell Learning Center, 15001 NE 36th Street, Redmond WA 98052 See the 1090 web site for travel maps and lodging information