Summary of Meeting #10, of RTCA SC-186, Working Group 5
For the Development of a MOPS for UAT
http://adsb.tc.faa.gov/ADS-B/186-subf.htm

The meeting was held on 28 January through 1 February 2002, in a Conference Room at the Atlanta Airport Marriott. The meeting was called to order at 9 a.m. on 28 January 2002 by Co-Chairman George Ligler. George provided introductory remarks, welcomed all attendees and asked that each one introduce themselves and their organization. The attendees included:

Larry Bachman – JHU – APL	Richard Jennings FAA (AIR-130)	Tom Pagano – FAA Tech Ctr – ACT-350
Mike Biggs – FAA – ASR-200	Stan Jones – Mitre CAASD	Ei Mon Phyu – Titan – FAATC – ACT-350
Mike Castle – JHU – APL	Todd Kilbourne, Trios Associates	Bob Saffell – Rockwell Collins
George Cooley, UPS Aviation Technologies	Greg Kuehl – UPS Airlines	Tom Teetor – Defense Concept Associates
Nikos Fistas – Eurocontrol	George Ligler – PMEI	David Thomas – Titan - FAATC –ACT-350
Gary Furr – Titan Corp - FAATC – ACT-350	Robert Manning – HQ USAF/XOR GANS	Ed Valovage – Sensis Corp.
Carl Gleason – Advancia – FAA/NISC	Chris Moody – Mitre CAASD	Cmdr Richard Weathers – US Navy JCS J6T
James Higbie – JHU – APL	Tom Mosher – UPS Aviation Technologies	Warren Wilson – Mitre Corp.

1. The following known regrets to attendance to this meeting were received prior to, or during the meeting:
   - Vincent Nguyen, FAA – AND-510
   - John Doughty, Garmin International

2. The Working Group was asked to review and approve the Minutes to Meeting #9. An editorial correction was made to the Minutes of Meeting #9 and the revised file will be posted on the ADS-B/UAT web site as version "A."

3. The Working Group discussed future meeting dates and locations. The following table indicates the currently agreed upon meeting dates and places for meetings of RTCA SC-186 Working Group #5.

Dates/Time	**Meeting Place**
9am Monday, 4 March to 4pm, Thursday, 7 March	Confirmed at Eurocontrol Headquarters, Brussels Belgium in the Neptune Conference Room, hosted by Nikos Fistas *Eurocontrol hotel rates for 2002 are still being negotiated, but available Brussels hotels are detailed on the ADS-B/UAT web site*
9am Monday, 8 April to noon Friday, 12 April	To be held in conjunction with the SC-186 Plenary at the RTCA facilities at 1828 L Street NW, Suite 805 (202-833-9339), MacIntosh Conference Room. Plenary on Wednesday & Thursday, 10-11 April. Travel info and lodging details are available on the ADS-B/UAT web site
9am Monday, 29 April to 4pm Friday, 3 May	Hosted at the William J Hughes FAA Technical Center in Atlantic City NJ Travel info and lodging details are available on the ADS-B/UAT web site
9am Monday, 17 June to 4pm Friday, 21 June	To be held in conjunction with the SC-186 Plenary at the RTCA facilities at: 1828 L Street NW, Suite 805 (202-833-9339) WG-5 to meet Mon, Tues & Wed with Plenary on Thurs & Fri Travel info and lodging details are available on the ADS-B/UAT web site
	Fall 2002 RTCA SC-186 Plenary tentatively scheduled for Wednesday & Thursday, 18-19 September.

4. The Working Group continued with a review of the "Key Physical Layer Parameters" which need to be decided upon for inclusion in the UAT MOPS. All of the undecided elements were highlighted in yellow, as shown in the initial matrix at the end of these Minutes in Figure 1. The matrix shown in Figure 1 was the final matrix agreed upon at the close of Meeting 9 at RTCA in Washington DC.

   As part of the review process of undecided issues, the Working Group began with the review of Working Paper WP-10-11, presented by Larry Bachman and Mike Castle as the results from simulations requested in Action Items 8-9, 9-5, 9-6, 9-7, 9-8 and 9-9. After review of the results in WP-10-11 for LA2020 and Core Europe 2015, the Working Group ***agreed*** that:

   a. there will be an A0 equipment class,
   b. there will be a Low and High definition for the A1 and B1 equipment classes where the power level for the Low is 38.5 to 42.5 dBm, and the altitude is less than 18,000 feet. The power level for the High is 42 to 46 dBm, and is defined for all altitudes.

   Following these agreements by the Working Group, the Key Physical Layer Parameters matrix was updated as shown in Figure 2 at the end of these Minutes.

5. Continuing with Agenda Item 5, the Working Group began the review of Working Paper WP-10-4, presented by Mike Biggs as the proposed Appendix G, "Standard Interference Environment." Upon initial review, Mike indicated several areas where additional information was required, such as the DME power levels in Table G-1 and the blanking times in Table G-2. Some modifications were made to WP-10-4 during the meeting and these changes were re-presented by Mike later during the meeting. It was ***agreed*** by the Working Group that with the addition of antenna patterns, the content of Appendix G was complete and required no further review by the Working Group. Mike will deliver a final draft of Appendix G prior to the Brussels meeting. During the discussions on Appendix G, it was ***agreed*** by the Working Group that a new Appendix K would be added to the UAT MOPS document by Larry Bachman to outline the "UAT System Performance Simulations Results," in draft form for review by the April Washington DC Meeting #12.

6. Holding to Agenda Item 6, at 1pm on Monday, 28 January 2002, the Working Group joined in a teleconference with members of WG-3 and WG-6 to discuss the issue of changes to TCP/Intent in the proposed DO-242A. This teleconference lasted for a little over 3 hours and resulted in agreed upon rates for TSR and TCR, which will be published in DO-242A. Another teleconference was scheduled for Tuesday, 29 January at 1pm to discuss the data elements of the TSR and TCR, and the resolution requirements for those data elements. This second teleconference was cut short by events and it was agreed by all parties to hold a follow-up teleconference on Tuesday, 5 February 2002 to continue discussions on the TSR and TCR data elements.

7. Following the initial TCP/Intent teleconference, the Working Group continued with Agenda Item 7 to hold a Group discussion on how to handle Intent Requirements in the June 2002 UAT MOPS document. Several topics were discussed during this period. The conclusions of these discussions are as follows:

   a. Following a discussion on standardization of inputs of Intent data, the Working Group ***agreed*** that requirements and test procedures would be written for a "data element by data element" basis, instead of specifying some sort of an "Intent Application" black box. The Working Group ***agreed*** to include the requirements for TSR in the June 2002 UAT MOPS, assuming that some questions can be answered soon by WG-6.

b. Following a discussion on whether or not to include detailed requirements for the TCR in the June 2002 UAT MOPS, the Working Group ***agreed*** to discuss TCRs in a general manner in a proposed Appendix "L" and run any necessary additional simulations (few, or none may be necessary) to reflect the impact of TCRs for the June 2002 UAT MOPS. This approach will require that a Revision A, or supplement, to the June 2002 UAT MOPS for detailed specifications of TCR-related requirements and test procedures be started as soon as possible after completion of both DO-242A and the UAT MOPS draft for the June 2002 Plenary ballot.

c. The Working Group ***agreed*** to require that TSRs would be optionally transmitted by the A1H equipment class. The Working Group has determined that we will meet the 12-second update rate requirement being proposed in DO-242A, even in the worst-case environment in Core Europe 2015, and we therefore will not run any further simulations for this case.

8. Continuing on the Agenda with Item 8b, Warren Wilson presented Working Paper WP-10-01, which addressed Action Item 9-10. This Working Paper addressed issues related to the number of overlapping ADS-B signals that need to be accommodated. The main finding of the Working Paper is that a receiver that can handle three simultaneous overlapping signals will be able to receive the vast majority of cases. Related test procedures for the UAT MOPS were also discussed in the Working Paper. During discussions on WP-10-01, Tom Pagano agreed that the Test Procedures proposed by Warren would be used, but that they needed to be expanded to consider uplink messages.

9. The Working Group continued to Agenda Item 9 with a discussion on the status of the various sections of the UAT MOPS. Starting with the table of "Draft UAT MOPS Sections" which has been a part of the Minutes of each UAT MOPS Meeting, the Working Group reviewed the status of each section and asked for reviewers to volunteer to review sections of the MOPS that do not require a page-by-page review from the entire Working Group membership. The result of that review, and the assignment of reviewers, is displayed in the table below. For the remainder of UAT MOPS effort, this table will continued to be updated at each meeting, or with the submission of each revision of each section or appendix. This table, without the list of reviewers, is also posted on the ADS-B/UAT web site. Team leaders are shown with an asterisk beside the name.

File Names (*.PDF)	Dated	Description	Writer(s)	Reviewers
Sec_1a	3/27/01	Draft 1 of Section 1 – Introduction *(Will have new draft before Brussels meeting)*	Bill Flathers *	George Ligler * Chris Moody Rich Jennings
Sec_2-1c	9/21/01	Draft 3 of Section 2.1 – General Requirements *(Will have new draft for Brussels meeting)*	Tom Mosher	All
Sec_2-2h	1/22/02	Draft 8 of Section 2.2 – Equipment Performance Requirements	Chris Moody * Bob Saffell Rich Weathers Jim Maynard JHU-APL	All
		Section 2.3 – Environmental *(Summary of baseline list of tests to be drafted for Brussels meeting)*	Bob Saffell	All
		Section 2.4 – Equipment Test Procedures (Review in Brussels, those test procedures for requirements agreed to in Atlanta)	Tom Pagano * Bob Saffell Tom Mosher JHU-APL (?)	All
		Section 3 – Installed Equipment Performance *(Will have a draft available for review team for Brussels)*	Greg Kuehl George Ligler *	Tom Teetor Tom Mosher

File Names (*.PDF)	Dated	Description	Writer(s)	Reviewers
Sec_4c	6/7/01	Draft 3 of Section 4 – Equipment Performance Characteristics	Greg Kuehl	Bill Flathers Tom Teetor *
Appendices:				
App_A6	2/6/02	Draft 6 of Appendix A – Glossary and Acronyms	Rich Jennings	Chris Moody * Bob Manning
App_B3	1/22/02	Draft 3 of Appendix B – ADS-B MASPS Cross Reference Matrix *(Hold draft at current level until approval draft of DO-242A is available)*	Greg Kuehl * Jim Maynard Nikos Fistas Larry Bachman	All
App_C2	01/15/02	Draft 2 of Appendix C – Example ADS-B Message Encoding *(Ready for Plenary with changes approved at Mtg 10)*	John Barrows Ei Mon Phyu	
App_D1	2/14/01	Draft 1 of Appendix D – UAT Ground Infrastructure *(Need new draft available for Brussels)*	Ed Valovage * Carl Gleason	George Cooley Mike Castle *
		Appendix E – Aircraft Antenna Characteristics *(Will have a draft available for Brussels meeting)*	Greg Kuehl Stan Jones George Cooley *	Bob Saffell Warren Wilson * Larry Bachman
		Appendix F – Link Budgets and Scenario Dependent Ranges	Larry Bachman Stan Jones	George Cooley Warren Wilson Ed Valovage *
App_G3	1/22/02	Draft 3 of Appendix G – Standard Interference Environment *(Ready for Plenary with changes approved at Mtg 10)*	Mike Biggs	All
App_H1	9/14/01	Draft 1 of Appendix H – Synchronization Processing Information *(New draft to be available for WG approval at Brussels meeting)*	Warren Wilson	All
App_I2	1/22/02	Draft 2 of Appendix I – UAT Timing Considerations	Chris Moody Tom Mosher	John Doughty Rich Jennings Bob Saffell
App_J2	1/22/02	Draft 2 of Appendix J – Recommended Report Output Format *(New draft for WG approval ready for Brussels meeting)*	Chris Moody Tom Mosher John Doughty	All
		Appendix K – UAT System Performance Simulation Results *(Will have draft for April DC meeting)*	Larry Bachman	All
		Appendix L – Anticipated TCR Message Format *(Draft 1 available for Brussels meeting)*	Chris Moody	All
WP-10-2A	1/24/02	Appendix M – UAT Error Detection and Correction Performance *(Ready for Plenary with changes that were approved at Mtg 10)*	Warren Wilson	

10. The meeting continued with the Working Group addressing Agenda Item 10. Tom Pagano asked that the review of Pre-MOPS equipment testing by JSC be deferred until a later time when open issues relating to the testing could be discussed by a smaller group. However, Tom Pagano did continue with the presentation of charts related to Co-Site testing on the Pre-MOPS units and the comparison to similar tests run against the Capstone units some months ago. This presentation was labeled as Working Paper UAT-WP-10-12 and was posted on the ADS-B/UAT web site in the Meeting 10 table. Upon review of these charts, the Working Group ***agreed*** that the co-site testing done at FAA-TC verifies the work done at JHU-APL and that no further co-site testing would be required.

11. The Working Group then turned its attention to Agenda Item 8c with the presentation of Working Paper WP-10-6 by James Higbie as an Update on MER Modeling Discrepancy in DME Interference.

James reported that the 4 dB discrepancy between measured and predicted MER for DME interference (reported in WP-8-04) has been resolved/eliminated, based on new MER measurements and modifications to the simulation model.

12. James Higbie continued with the presentation of Working Paper WP-10-05 as the Description of the Receiver Model for Multi-Aircraft UAT Simulations. It was ***agreed*** by the Working Group that this Working Paper would be used as introduction material for a newly proposed Appendix "K" to be written by Larry Bachman, entitled "UAT System Performance Simulation Results."

13. Under Agenda Item 11g, the Working Group briefly reviewed Working Paper WP-10-03, as the proposed draft of Appendix C. It was pointed out that the values in Tables C-1 and C-2 were dependent on the data formats as they are currently defined, and that a note should be added to each table making that statement. WP-10-03 was approved by the Working Group as ready for Plenary review with the stated addition of the notes to the two tables. Once the notes are added, Appendix C will be posted again to the ADS-B/UAT web site.

14. Continuing on with Agenda Item 11i, Tom Mosher presented Working Paper WP-10-10, which presented draft 2 of the proposed Appendix J: Reference Upper-layer Report Format. Some changes were discussed during the review and Tom will make those suggested changes and present the Appendix to the identified review team for additional review.

15. Warren Wilson presented Working Paper WP-10-02A as a proposed draft of a new Appendix to be entitled "UAT Error Detection and Correction Performance." Some minor changes were discussed relating to soft encoding versus hard encoding, but otherwise, the Working Group approved the document as a new Appendix "M" and ***agreed*** that it is ready for Plenary review with the changes discussed. Once the changes are made to the text, Appendix M will be posted to the ADS-B/UAT web site.

16. The Working Group then began the review of Section 2.2 text presented in Agenda Item 11c in Working Paper WP-10-09 by Chris Moody. During review of Section 2.2, the Working Group returned to the JHU-APL Simulation results in WP-10-11 to answer the question of whether or not to specify the 1.2 MHz filter in both the A2 and A3 equipment. It was determined that in the Core Europe 2015 scenario, in order to meet requirements, we should use the 0.8 MHz filter in the A3 equipment. It was therefore ***agreed*** by the Working Group that the 0.8 MHz filter would be specified for the A3 equipment class.

17. Additionally, during the review of Section 2.2, questions were raised by Group members, which led the Working Group to review the "Orphaned Issues List," which has been shown in the Minutes to each UAT meeting since Meeting #3. Following review and discussion of each of the remaining open orphaned issues, the list is presented as shown in the table below. After Working Group discussions, there remained NO OPEN ORPHANED ISSUES. Therefore, after these Minutes are published, the Orphaned Issues List will be retired.

Issue #	Issue/Question Description	Raised by	Date Raised	Status
1	What is the best approach to determining the length of the ADS-B message for proper R/S decoding? If a separate 8 bit length ID field is used outside the R/S block – as is the current Capstone approach – could a half rate code supporting 4 information bits be supported to identify payload type? If the length ID is only 2-state, could it be shortened from 8 bits?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-15** **CLOSED**

Issue #	Issue/Question Description	Raised by	Date Raised	Status
2	What is the best combination of CRC and FEC for meeting integrity requirements most efficiently	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-15** **CLOSED**
3	Quantify the benefits for "preamble re-trigger" and specify if necessary • How many parallel decode paths are needed? • How to deal with sync pattern in the data?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-5-11A** **CLOSED**
4	What is the optimum sync threshold "score" that is best matched to the overall message decoding success while minimizing false alarm for re-trigger? Should the threshold be specified? If so, how is it tested? **Being addressed in new Appendix H.**	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-12** **WP-4-18** **WP-5-11A** **CLOSED**
5	Can a minimal installation without an "On Ground" indication continue alternating top and bottom antennas for transmit without significantly sacrificing performance?	Chris Moody UAT-WP-2-06	20 Feb 01	Replaced by #10 **CLOSED**
6	What is the minimum isolation required for antenna switching (20 dB in 1090 MOPS)?	Chris Moody UAT-WP-2-06	20 Feb 01	In Sec 3 **CLOSED**
7	Is an explicit specification needed to describe the filtration on the transmitted signal? If so, how to specify? If not, what implementation loss are we allowing?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by several Action Items **CLOSED**
8	What kind of receive filtration specification is required?	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by several Action Items **CLOSED**
9	What minimum specification is required on baud rate timing to allow reception of the entire uplink using a single sync sequence? Is it practical to require this minimum? **Answer is 20 PPM.**	Chris Moody UAT-WP-2-06	20 Feb 01	Addressed by **WP-4-11** **CLOSED**
10	Whether or not to require an algorithm to determine On-the-Ground status. **See DO-260 Figures 2-9A/B. Additionally need to require transmission requiring top antenna only when air-ground indication is "Ground."**	Section 2.2 discussion	2 May 01	**CLOSED**
11	Given that the agreed-upon solution to Coding Selected Altitude appears to add 2 bits, we will remember that we can revisit this issue later if we need to recover those bits.	Discussion on Coding Selected Altitude in WP-4-03	3 May 01	Agreed on TSR **CLOSED**

18. The following **Action Items** were identified during the course of this and previous meetings. 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, in total or in part, after the end of the Meeting being report on in these Minutes.

Action Number	Action Description	Assigned to	Status
3-6	Mike and Gondo to determine criteria for acceptable DME performance in the presence of UAT interference	Mike Biggs Gondo Gulean	Assess again at Meeting 11

Action Number	Action Description	Assigned to	Status
6-6	Draft Appendix B.2 on FIS-B MASPS compliance.	George Ligler Chris Moody	Assess at Meeting 11
8-14	How many transmissions in the ground segment before we loose continuity.	Larry Bachman Stan Jones	
8-16	Draft of Section 2.2.6.3.3 for the December Meeting #9, regarding Latency for NUC <=7 and for >7.	George Ligler (*) Stan Jones	Assess at Meeting 11
9-8	Run simulation with cavity filter for ground station and sensitivity analysis for 100 w DME as opposed to 10000 w DME.	Larry Bachman	
9-9	Scale down aircraft equipage in the current European environment to assess what level can be supported while meeting requirements. Alternatively assess what subset of requirements can be met in the presence of existing 978 MHz DMEs.	Larry Bachman	
9-13	Assess TCR reception performance at 50 NM and 90 NM at 95% in Future Core Europe for A3 equipment transmitting each TCR once per epoch. Try to complete prior to 12 January 2002.	Larry Bachman	
9-14	Give a detailed review of the draft of Appendix H, which is currently available as WP-7-05.	Stan Jones	
10-1	Run probes for A0 equipment for air-ground performance in LA and Core Europe at ranges above 100NM.	Larry Bachman	
10-2	Run close-in probes for Core Europe 2015 for air-ground performance. Assess improvements to the ground stations for Core Europe 2015 to improve performance in the 40-50NM range.	Larry Bachman Chris Moody Ed Valovage	
10-3	Develop recommended decoder throughput requirements by equipment classes, for self-interference only. Include consideration of theoretical peak and FIS-B Uplink requirements.	Warren Wilson Larry Bachman (*) Stan Jones	
10-4	Simulate the reception of different aircraft on approach (2000 feet) by A0 on the ground.	Mike Castle Larry Bachman	
10-5	Insert a short paragraph into Section 1 concerning Appendix M and the potential importance of its conclusions.	George Ligler	
10-6	Simulate Mode Status Report acquisition in Core Europe 2015. Present in Brussels.	Larry Bachman	
10-7	Update Table 2.2.8.2.3	George Cooley	
10-8	Provide numbers for Tables in sections 2.2.10.1 and 2.2.10.2 with rationale before the Brussels meeting. Take surface vehicles into account.	Larry Bachman Stan Jones	
10-9	Research and develop text to require switched antenna installations to use top antenna only for both transmit and receive when known to be on the surface.	Tom Mosher	
10-10	Confirm appropriate numerical requirements for section 2.2.8.2.5. To be provided to Chris and Tom Pagano by email.	James Higbie	
10-11	In order to pre-finalize requirements for section 2.2.4. Chris Moody will have a draft for telecon group by COB Thursday, 2/7/02. Telecon to be held 1pm Monday 2/11/02, for minimum of 3 hours. Draft test procedures to be developed thereafter.	Chris Moody Tom Pagano + team John Doughty Bob Saffell UPS-AT Team Rich Jennings	

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-5 Meetings, as well as the Meeting Agendas, Meeting Minutes, Meeting Schedules and files leading to the production of a UAT MOPS are posted on the ADS-B UAT web site at: http://adsb.tc.faa.gov/ADS-B/186-subf.htm

Working Paper	Size	Description	Introduced At:
UAT-WP-10-1	46KB	UAT Message Overlap Statistics, presented by Warren Wilson in response to Action Item 9-10	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-2A	25KB	Proposed text for a possible Appendix dealing with UAT Error Detection and Correction Performance, presented by Warren Wilson	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-3	111KB	Draft 2 of the Proposed Appendix C – Example ADS-B Message Encoding, presented by John Barrows and Ei Mon Phyu	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-4	29KB	Draft 3 of the Consolidated Proposed Appendix G – Standard Interference Environments, presented by Mike Biggs	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-5	207KB	Description of the Receiver Model for Multi-Aircraft UAT Simulations (MAUS), presented by James Higbie	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-6	153KB	Update on MER Modeling Discrepancy in DME Interference, presented by James Higbie	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-7	29KB	Draft 2 of Appendix I: UAT Timing Requirements, presented by Chris Moody and Tom Mosher	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-8	54KB	Draft 3 of the Proposed Appendix B: The ADS-B MASPS Cross Reference Matrix, presented by Greg Kuehl	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-9	137KB	Draft 8 of Section 2.2 of the UAT MOPS, presented by Chris Moody	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-10	14KB	Draft 2 of Appendix J: Reference Upper-Layer Report Format, presented by Tom Mosher and John Doughty	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-11	144KB	Multi-Aircraft UAT Simulator Results for Various Scenarios, presented by Larry Bachman and Mike Castle in response to Action Items 8-9, 9-5, 9-6, 9-7, 9-8 and 9-9	Meeting #10, 1/28/02 Atlanta, GA
UAT-WP-10-12	38KB	Co-Site Testing Results – Pre-MOPS Units versus Original Capstone 981, presented by David Thomas and Tom Pagano in response to Action Item 8-11	Meeting #10, 1/28/02 Atlanta, GA

Figure 1
Key Physical Layer Parameters to be Decided for Inclusion in the UAT MOPS at the end of Meeting 9

		ADS-B Equipment Classes Supported in UAT MOPS					
		A0 (will this Class exist??)	**A1**	**A2**	**A3**	**B1** (Aircraft Tx-only)	**B2** (Ground Vehicle Tx Subsystem)
Message structure and FEC definition		Short ADS-B → RS (30,18); Long ADS-B → RS (48,34); Uplink → 6XRS(92,72) interleaved					
Transmitter ERP (dBm at antenna end of feedline)		38.5-42.5	42-46 (Lower power for low altitude subclass possible)	42-46	50 – 54	Same as A1	28-32
Receiver Sensitivity (dBm for 90% MSR at antenna end of feed line)		-93	-93	-93	-93	N/A	N/A
RX Filtering		Regular selectivity requirement (1.2 MHz)	Regular selectivity requirement (1.2 MHz)	Regular selectivity requirement (1.2 MHz)	Narrow selectivity requirement (0.8 MHz)	N/A	N/A
Antenna Diversity	TX	Bottom only	Alternate T/B*	Alternate T/B	Alternate T/B	Same as A1*	Single Antenna
	RX	Bottom only	Alternate T/B*	Full time dual	Full time dual	N/A	N/A

*Single antenna exemptions for special categories of aircraft (e.g. balloons and gliders)
Yellow highlight shows areas yet to be closed by the MOPS committee

Figure 2
Key Physical Layer Parameters that are Decided for Inclusion in the UAT MOPS through the end of Meeting 10

		ADS-B Equipment Classes Supported in UAT MOPS					
		A0	**A1 (L/H) ****	**A2**	**A3**	**B1 (L/H) **** (Aircraft Tx-only)	**B2** (Ground Vehicle Tx Subsystem)
Message structure and FEC definition		Short ADS-B → RS (30,18); Long ADS-B → RS (48,34); Uplink → 6XRS(92,72) interleaved					
Transmitter ERP (dBm at antenna end of feedline)		38.5-42.5	38.5 – 42.5 (L) 42 – 46 (H)	42-46	50 – 54	38.5 – 42.5 (L) 42 – 46 (H)	28-32
Receiver Sensitivity (dBm for 90% MSR at antenna end of feed line)		-93	-93	-93	-93	N/A	N/A
RX Filtering		Regular selectivity requirement (1.2 MHz)	Regular selectivity requirement (1.2 MHz)	Regular selectivity requirement (1.2 MHz)	Narrow selectivity requirement (0.8 MHz)	N/A	N/A
Antenna Diversity	TX	Bottom only	Alternate T/B*	Alternate T/B	Alternate T/B	Alternate T/B*	Single Antenna
	RX	Bottom only	Alternate T/B*	Full time dual	Full time dual	N/A	N/A

* Single antenna exemptions for special categories of aircraft (e.g., balloons and gliders)
** High Altitude A1/B1 is defined for all altitudes. Low Altitude A1/B1 is defined as less than 18,000 feet