RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #17

Consolidated List of Comments Received Against The Plenary Draft of DO-260A

Presented by Gary Furr

SUMMARY
This is a summary of all of the comments that were submitted by SC-186 members against the Plenary draft version of DO-260A. All comments were resolved and their resolution so noted in this document. Verification of implementation of the proposed comment or resolution has been completed and DO-260A has been updated with each resolution, as per RTCA SC-186 Plenary direction.

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
1	1	Chris Moody	Appendix O		Is TC performance estimate accounting for the additional load on the channel from the transmission of TC information? If so, how does it impact the State Vector and other information updates?	Make clear in the Appendix the context for the analysis or limitations. **WG-3 Response: Agreed** WG-3 proposes that the following text be placed at the end of the 2nd paragraph of O.5.1: "*The effects of increased loading on the 1090 MHz channel from the increased rate of Extended Squitter transmissions that would be necessary to accommodate TC Reporting have not been considered in the analysis. The effect of the increased channel loading is expected to be minor for the case where the total Extended Squitter transmission rate is limited to 6.2 squitters per second. As the requirements for TC Reporting mature, further studies should be conducted to determine an appropriate upper limit on Extended Squitter transmission rates and under what conditions such maximum transmission rates would be permitted.*" **Done**

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2	2	Chris Moody	Appendix L		Not clear how most rows in the table even relate to DO-260A equipment. The only one really pertinent seems to be the very last row. It also seems that results will be very implementation dependent.	Delete all but the last row of table and note that the results are based on a software simulation and that results will be implementation dependent. **WG-3 Response: Agreed with modification** The tabulated information should be retained because it supports the two trends stated in the text. To address this comment, some explanation has been added, showing the relationship between the table and the four classes. Regarding implementation dependence, the conclusion from the error rate analysis is that the sliding window technique that is used in TCAS would be inappropriate for the classes having lower MTL values. As a result, the MOPS explicitly requires that the sliding window technique not be used for those classes. Additional implementation dependence is still possible, so the text was modified as suggested adding a new requirement in §2.4.4.4.3.1 to explicitly satisfy the MASPS requirement. Suggest adding an additional paragraph after the table and before the figure stating that: "The last row applies directly to class A3 equipment, and the first row applies to class A0. Because of the higher MTL values in classes A2 and A1, relative to A3, lower error rates are expected, but because of the statistical nature of the Monte Carlo technique, it was not practical to evaluate these cases directly. The summary that follows provides error rate bounds for these two classes. - Class A3, error rate is approximately 0.05 x (10^{-6}) per report - Class A2, error rate < 0.05 x (10^{-6}) per report - Class A1, error rate < 0.05 x (10^{-6}) per report - Class A0, error rate is approximately 0.09 x (10^{-6}) per report." **Done**

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3	3	Chris Moody	Table F-1		For requirement R3.39, (integrity) the stated "Compliance/Notes" section seems to relate to interrogation/reply, so it does not verify the integrity requirement for broadcast. Also, the statement on "single string" equipage does not seem relevant to message integrity.	Replace text in the Compliance/Notes section with information on integrity of the ADS-B message broadcast. **WG-3 Response: Agreed** **Done**
4	1	Ron Jones	Table 2.2.8.2	192	Editorial: In column 3 the name "Aircraft Identification" is incomplete to identify the Aircraft ID & Type Message.	For the parameter 1, 5a and 5b entries in column 3 change "Aircraft Identification" –to- "Aircraft ID & Type" **WG-3 Response: Agreed** **Done**
5	2	Ron Jones	2.1.12.2	27	It appears that MS reports were omitted as a requirement for Class A0 receivers under the right most column of Table 2-5.	Add MS reports as a requirement for Class A0 receivers under the right most column of Table 2-5. **WG-3 Response: Agreed** **Done**
6	1	FAATC ACB-410	2.4.2.2.1, 2.4.2.2.10.2, 2.4.2.2.10.3, 2.4.3.1.1, 2.4.3.1.2, 2.4.3.1.3, & 2.4.3.1.4	307, 308, 309, 310, 311, &312	The sentence "Load valid data into the ADS-B Airborne Position format and ensure…" should read: "Load valid Airborne Position Data into the ADS-B Transmitting Subsystem and ensure…" This same sentence is in each of the sections listed to the left.	Replace the existing sentences with the revised version. **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
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7	2	FAATC ACB-410	2.4.3.2.1.7	320	There is a TBD here intended for a revision of the last sentence in the section.	Begin the existing sentence with: "For Transponder Based Systems," followed by the sentence as is. Add this additional sentence: "For Non-Transponder Based Systems, where a means to change the ICAO 24-bit Address is provided and permitted by the appropriate regulatory authority, verify that the "AA" field (i.e., the ICAO 24-Bit Address) cannot be changed once the unit under test has been powered to the operational state unless the system is in standby mode as per section 4.4.6." **WG-3 Response: Agreed** **Done**
8	3	FAATC ACB-410	2.4.10.3.2	669	In steps 1 through 7 the (10) second period should be changed to (50) since this test is for Surface Participants.	Replace each instance of "(10)" with "(50)" in this test procedure. **WG-3 Response: Agreed** **Done**
9	4	FAATC ACB-410	2.4.10.4.2.1	679	In Purpose/Introduction part "d" the 100 +/- 5 seconds should be 200 +/- 5 seconds In the measurement procedure the (10) second period should be changed to (50) since this test is for Surface Participants.	Replace "100 +/- 5" with "200 +/- 5" Replace each instance of "(10)" with "(50)" in this test procedure. **WG-3 Response: Agreed** **Done**
10	5	FAATC ACB-410	2.4.10.4.2.2	681	In step 2 the 100 +/- 5 seconds should be 200 +/- 5 seconds.	Replace "100 +/- 5" with "200 +/- 5" **WG-3 Response: Agreed** **Done**
11	6	FAATC ACB-410	2.4.10.4.2.3	682	In the measurement procedure 25 +/- 5 seconds should be 225 +/- 25 seconds.	Replace "25 +/- 5" with "225 +/- 25" **WG-3 Response: Agreed** **Done**

<table>
<tr><th rowspan="2">#</th><th colspan="2">Original Comment</th><th rowspan="2">Section</th><th rowspan="2">Page</th><th rowspan="2">Comment</th><th rowspan="2">Suggested Resolution</th></tr>
<tr><th>#</th><th>Author</th></tr>
<tr><td>12</td><td>7</td><td>FAATC
ACB-410</td><td>2.4.4.4.2.5</td><td>527</td><td>Currently the 2.4.4.4.2.5 Data Block Tests with Mode S Fruit are conducted in 4 dB Signal to Interference Ratio increments. This results in only one significant test point, that being the SIR=4 dB point. The remaining test points are such that either 0% reception is required, or 99% reception is required. It is recommended that the test procedure be expanded to run in 1 dB steps (SIR) between 0 dB SIR and 8 dB SIR. The expanded test will better ensure that the Enhanced Squitter Reception implementation under test will perform as required in the presence of significant interference.

The following table provides the Success Criteria for the Data Block Tests with Mode S Fruit for class A1 and A3 equipment. (The Success Criteria is derived from measured results discounted by 5%) The criteria for class A2 equipment will be derived from Lincoln Labs 8 MHz simulation results.

<table>
<tr><td>Relative Power (S/I) dB</td><td>0</td><td>+1</td><td>+2</td><td>+3</td><td>+4</td><td>+5</td><td>+6</td><td>+7</td><td>+8</td></tr>
<tr><td>A1 Class</td><td>0</td><td>0</td><td>.02</td><td>.12</td><td>.56</td><td>.71</td><td>.94</td><td>.95</td><td>.99</td></tr>
<tr><td>A2 Class</td><td>0</td><td>0</td><td>.02</td><td>.12</td><td>.59</td><td>.8</td><td>.95</td><td>.99</td><td>.99</td></tr>
<tr><td>A3 Class</td><td>0</td><td>0</td><td>.02</td><td>.12</td><td>.59</td><td>.8</td><td>.95</td><td>.99</td><td>.99</td></tr>
</table>
</td><td>Accept the suggested resolution detailed at left and include the values in the appropriate tables in the MOPS. Change any text in 2.4.4.4.2.5 to account for the change in steps.

WG-3 Response: Agreed
Accepts the values as originally proposed and leave the values in the respective tables for the Relative Power level of +12 in the tables in 2.4.4.4.2.5.

Done</td></tr>
</table>

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	#	Author				
13	1	ICAO AMCP WG-C UAT Subgroup	Table 2.2.3.2.7.2.11 & Table A-26	123 & A-36	Regarding the Tables that identify the A/V Length & Width Code: During review of these tables by the ICAO AMCP Working Group "C" UAT Subgroup for the production of a UAT SARPS, it was agreed by the International community that there is a need to clarify these tables so that anyone could understand how to interpret the table, using only the table itself, and to have a table such that all aircraft could be assigned a specific A/V-L/W Code.	In order to easily apply the A/V L&W Tables to any aircraft of any size, it is suggested that all of the left sides of all of the inequalities for both the Length and Width columns of these tables be eliminated for A/V-L/W decimal codes 0 through 13, leaving only the cases where "L" is less than a value and "W" is less than a value, in order to determine the A/V-L/W Code. For the case of a A/V-L/W code of decimal 14 or 15, the entry for Length should be "L" less than some very large value (less than infinity) in order to adequately cover those aircraft that may be much wider than they are long. **WG-3 Response: Agreed** **Done**
14	1	Jerry Anderson	General		Use of "Stand-Alone" and "Non-Transponder" are not clear.	In the second sentence of 1.1 change "stand-alone" to "separate." Would it be possible, in the next version of the MOPS, to use mostly one term or the other? I like NTD. **WG-3 Response: Agreed** **Done**
15	2	Jerry Anderson	2.2.4.3.1.1	139	"MTL" is not appropriate in first sentence.	Delete "MTL" from first sentence. **WG-3 Response: Agreed** **Done**
16	3	Jerry Anderson	2.2.13.6	236	Diversity Antenna use is not clear.	Change first sentence to read, "Diversity transmission and/or reception is described in 3.3.1." **WG-3 Response: Agreed** **Done**

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17	4	Jerry Anderson	2.2.2.1 2.2.2.2 2.2.2.2.10.2 2.2.3.3.2 2.3.2.2.8 2.4.2.1 2.4.3.3.2 Table 3-1		Class B1 should be transponder-based.	In 2.2.2.1, add Class B1 to paragraph "a" and change "Class B" to "Class B0" in paragraph "b". In the first sentence of 2.2.2.2, 2.2.3.3.2, 2.3.2.2.8 and 2.4.3.3.2, change "Class B" to "Class B0" or, better yet, delete "for Class A0 and Class B equipment". Delete B1 from 2.2.2.2.10.2. Now, is the note still needed? In the note in 2.4.2.1 change "Class B" to "Class B0". In Table 3-1, change "B1/Type 1 (see Note)" to "A0/Type 1 (see Note)". **WG-3 Response: Agreed to all above changes** **Done**
18	5	Jerry Anderson	App. F (R3.12)	F-14	It is not clear if these MOPS are in compliance with Table 3-4(a) of DO-242A for the Airport Surface column (last row)?	If they are not, what should be said about it? Are there other unclear items in the matrix? Add the following disclaimer at the end of F.1, "This MASPS Compliance Matrix may not be complete in its analysis of every requirement relative to its use by a specific application. Care should be taken during the development of an application, to ensure that the performance of the 1090 MHz ADS-B system meets the requirements of that application." **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
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19	6	Jerry Anderson	2.2.3.3.2.3.d	133	This requirement is not clear. Does it mean when NIC and NAC are zero, but not when they are 1 or 2? What good is a NIC/NAC of 1 or 2, when you are on the surface? Aren't NIC or NAC of at least 8 or 9 needed for surface? Why transmit at the higher rate when you don't know where you are?	Replace 2.2.3.3.2.3.d with, "If the transmission device is transmitting a NIC or NAC_P less than 8, it shall use the "Low" transmission rate." **WG-3 Response: Agreed with Modifications** Following discussion, WG-3 agreed to place an additional Note following Table 2-11 and Table A-2 stating that: "*Future versions of these MOPS may limit transmission of Surface Position Messages at lower NIC and/or NAC_P values for Transponder-Based systems.*" **Done**
20	1	Bill Harman	P.4	P-38	Two low density environments. I suggest adding an explanation of why two low density environments were evaluated, and how they correspond to the low density environment specified in the MASPS.	In the last paragraph, I suggest adding the following at the end of the sentence: "(1250/sec. and 5000/sec., the first corresponding to the aircraft density defined in the MASPS, and the second somewhat elevated)." **WG-3 Response: Rejects the suggested resolution.** Paragraph remains as written.
21	2	Bill Harman	P.4	P-37	The distinction between LA2020 (24K) and the other environment was presented 37 pages earlier. I suggest adding a reminder here.	Change "24,000" to "24,000-nominal". **WG-3 Response: Agreed with Modification** Inserted a reference to §P.1 where 24,000-nominal is defined. **Done**
22	3	Bill Harman	P.2.1.1	P-6	Error rate. In the next to last bullet, MTL is described as "the signal level at which 10% error rate is achieved." This wording may be confusing. At MTL 90% of messages are received correctly. The others are missed, not received in error.	Proposed rewording of this sentence: "This represents the signal level at which 90% of messages are received correctly in the absence of interference." **WG-3 Response: Agreed** **Done**

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23	4	Bill Harman	P.2.2.2	P-8	Clarification. In the 4th paragraph, the subject changes from the A3 receiver to the A2 receiver. I propose making this more clear.	Suggest adding: "For the A2 receiver," at the beginning of the paragraph. Also revise the second sentence to: "Again, as for the A3 results from the FAATC, the A2 results from LL (which are plotted in Figure P-19) were presented ..." **WG-3 Response: Agreed** **Done**
24	5	Bill Harman	P.2.3.1	P-9	Redundancy. The first paragraph in this section seems redundant. The beginning of this appendix states that the LA2020 traffic model, as defined in the MASPS, was used for both APL and LL evaluations. It seems inappropriate to repeat this material here inside section P.2.	I suggest deleting the 1st paragraph. For the same reason, we should delete the first 2 major bullets in the list that follows, and also delete the last two paragraphs in this section. **WG-3 Response: Agreed with Modification** Placed a reference to the LA2020 scenario into §P.3) **Done**
25	6	Bill Harman	P.2.3.2	P-10	In the 1st paragraph, the first sentence is somewhat confusing because it refers to "the candidate links" and the SF21 Steering Committee. Perhaps the text was lifted from another document.	I propose deleting the first sentence. Also changing the next sentence from, "These requirements ..." to "The MASPS requirements ..." Also in the same paragraph, I suggest replacing "air/ground" with "air/air" **WG-3 Response: Agreed with Modification** **Done**
26	7	Bill Harman	P.2.3.2	P-10	Clarity. In the 2nd paragraph, I propose adding the word "pairs" in the second sentence, for clarity.	I suggest changing "95% of aircraft" to "95% of aircraft pairs ..". Also, I propose deleting the sentence "This metric was unanimously selected by the TLAT...", because it's not needed now that DO-242A is available. **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
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27	8	Bill Harman	P.3.3	P-33	Altitude effects. This wording is oversimplified. The small change in performance at shorter ranges can cause a more dramatic change in TSR range performance. Correcting this material is not critical, but might be useful to a reader who is interested in this detailed material.	See separate wording changes suggested including a revised figure in the attachment. **WG-3 Response: Agreed** **Done**
28	1	Pio Blankas	Appendix A, 1.4.5.7	A-22	In the paragraph after the note, TYPE codes 9 and 10 are incorrect for GNSS HAE	Change the TYPE codes to 20, 21 and 22. **WG-3 Response: Agreed with Modification** WG-3 suggests adding a sentence in the last paragraph of A.1.4.5.7 to clarify, stating that: "For Format TYPE Codes 11 through 18, either GNSS HAE or altitude MSL will be used." **Done**
29	2	Pio Blankas	Various		Add to the glossary (Appendix B) the following terms: TRS – Transmission Rate Subfield GFM – General Formatter/Manager ATS – Altitude Type Subfield SV – State Vector	See comment **WG-3 Response: Agreed with Modification.** Agreed except that ATS is already defined for "Air Traffic Services" **Done**
30	3	Pio Blankas	Appendix H.3.2.2	H-8	Typo in note 1: *In this case the Mode Status Report will use the most recently received message that contains the required data element (i.e., source will be either the Aircraft Operational Status Message OR the Target State an Status Message.*	Change to the highlighted **BOLD** text *In this case the Mode Status Report will use the most recently received message that contains the required data element (i.e., source will be either the Aircraft Operational Status Message OR the Target State **and** Status Message**).*** **WG-3 Response: Agreed** **Done**

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31	4	Pio Blankas	Appendix J.3.3	J-5	Typo in the first paragraph after the equation:	Change “airborne” to “Airborne” in the title to DO-208. **WG-3 Response: Agreed** **Done**
32	5	Pio Blankas	Sections 2.2.3.2, 2.2.3.3.2.1.12 .2.3.3.2.1.22. 2.3.3.3, 2.2.3.3.4, 2.2.3.3.5, 2.2.3.3.6.1, 2.2.3.3.6.2, 2.2.3.3.6.3, 2.2.3.3.2.11, 2.2.3.3.2.12, 2.2.4.2, 2.2.4.3.4.1, 2.2.4.5, 2.2.5.1.9, 2.2.5.1.11, 2.2.8.1.7 – through 2.2.8.1.12. 2.2.8.1.14, 2.2.8.1.15, 2.2.8.1.21	132-138, 141, 144, 152, 153, 181-184, 190	The paragraphs are tagged with a level which is inconsistent with the rest of the document	Remove the first level of numbering. That is, remove the outline numbering that start with a letter: a., b., **WG-3 Response: Rejected** The section numbering reflects the document organization that was intended by the Working Group.
33	6	Pio Blankas	2.2.6.1	170	Formatting errors: - Outline level is inconsistent with rest of document - Paragraph after “b” is outside the margins	Fix formatting **WG-3 Response: Agreed** **Done**
34	7	Pio Blankas	2.2.8.2.1.1	194	Last paragraph on page has the last 3 lines in bold text. Only the “shall” needs to be in bold text.	Remove the unnecessary bold text. **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
35	8	Pio Blankas	2.2.8.2.16	201	First paragraph, typo: "Reprt" should be "Report"	Fix typo **WG-3 Response: Agreed** **Done**
36	9	Pio Blankas	2.2.8.3.2.1.1	210	Last paragraph on page has the last 4 lines in bold text. Only the "shall" needs to be in bold text.	Remove the unnecessary bold text. **WG-3 Response: Agreed** **Done**
37	10	Pio Blankas	Appendix I.4.2.1	I-12	Second to last line: change "meet" to "met"	Fix typo **WG-3 Response: Agreed** **Done**
38	1	Judy Loewe	Appendix A.1.4.3.4.1	A-15	ICAO Vol. III Amendment 7 entitles BDS 0,6h as Heading. DO-260A calls BDS 0,6h "Ground Track"	Prefer to keep the ICAO nomenclature. **WG-3 Response: Rejected** DO-260A redefines that field to reflect Heading and this change is being coordinated with ICAO SCRSP.
39	2	Judy Loewe	Appendix A.1.4.3.2.1	A-16	DO-260A does not define the transition point of "close to zero".	Change "close to zero" to "below 40 knots" **WG-3 Response: Rejected** WG-3 suggests changing the term "close to zero" to "low." The transition speed was intended to be flexible to accommodate the characteristics of different implementations. **Done**
40	3	Judy Loewe	Appendix A.1.4.5.5	A-20	Table A-5 contains VFOMR values that are more precise than the ICAO Vol. III Amendment 77 (Table 2-9A).	Revise to the ICAO standard. **WG-3 Response: Rejected** This parameter has been redefined by DO-242A to be NAC_V instead of NUC_R. This change is being coordinated with ICAO SCRSP.

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41	1	Tony Warren	Appendix O.4	O-7 O-20	The argument is made based on the nominal allocation of extended squitter transmission rates, that the 1090 Mhz ADS-B system cannot support more than a single TCP, if the recommended transmission rate is the same as that for Target State data, i.e. 0.8 per second since the total ADS-B transmissions will then be at the max allowed limit of 6.2 transmissions per second. This reader notes that the position and velocity squitters, which are highly redundant in information content, are each being broadcast at 2.0 squitters per second, using about 60% of the available transmission rate for 1090 Mhz ADS-B. This squitter rate is based on the notion that we need to pair a position and velocity report in order to do a state update. This is not true if you require a tracker on the receive side, i.e. in that case you only need to broadcast velocity squitters at about HALF the rate of position squitters, since a tracker will update both position and velocity estimates based on the latest squitter received. My guess is that you only need position squitters at a rate of about 1.6 per second and velocity squitters at a rate of about 0.8 per second to meet all the requirements of the ADS-B MASPS at both short and long ranges, i.e. a total of somewhere between 2 and 3 squitters per second to generate state vector reports. If this could be done, then another 1 per second squitter broadcast would become available for future requirements such as broadcasting TCP's or ARV messages, while continuing the broadcast of basic ADS-B data.	(1) Increase the 1090 MOPS squitter rate to meet future growth requirements, e.g. to 7 or 8 per second. (2) (Preferred) Use a reduced rate of velocity squitters compared to position squitters and a tracker on the receive side to generate state vector reports whenever the track is fully established and a position or velocity update is received. The goal should be to reduce the squitter rate for state vector broadcast from 4 per second to 3 per second or less. If the simulation studies cannot be accommodated in time for changing the MOPS standard, then at least allow vendors the capability to go this route, provided that they can show they meet the ADS-B MASPS reception and accuracy requirements. **WG-3 Response: Agreed with Modification** Discussion of WG-3 with Tony Warren indicates that work is being done to increase the squitter rate that is currently set at 6.2 per second to a larger number. Unfortunately, this activity will not be completed in the very near term. Tony agrees that this promise satisfies this comment.

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42	1	Stuart Searight	General	--	Throughout the document, both "Non-transponder Devices" (or NTDs) and "Stand-Alone" Transmitters are used. Is there any difference inferred by the different terms? If not, one should be used throughout the document.	Replace all instances of "Stand-Alone" and "Stand Alone" with "Non-Transponder-Based". **WG-3 Response: Agreed with Modification** WG-3 agrees only to standardize on "Stand Alone." **Done**
43	2	Stuart Searight	2.2.2.2.10	33	RF Peak Output Power: The sentence in this section is an empty requirement, in that it says equipment shall meet the requirements specified in the proceeding subsections.	Change the sentence to read as follows: "The RF peak output power requirements of each pulse of each transmitted message at the terminals of the antenna are ~~**shall be as**~~ provided in the following subparagraphs for each class of equipment addressed." **WG-3 Response: Agreed** **Done**
44	3	Stuart Searight	2.2.2.2.10.2	33	Class B1, B2, and B3 Equipment RF Peak Output Power: A note should be added to mention the "B2 Low" equipage class which will meet all B2 requirements except 18.5 dBW (70W) RF peak output power.	Add appropriate note, referencing §2.2.3.2.7.2.3.8. **WG-3 Response: Agreed.** Add a note indicating: "*ADS-B equipment that meets all requirements of Class B2 with the exception of this RF peak output power requirement is identified by the use of the "B2 Low" Capability Class Code as specified in §2.2.3.2.7.2.3.8."* **Done**

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45	4	Stuart Searight	2.2.3.2.7	101	ADS-B On-Condition Messages: While there are no conditions specified in DO-242A under which Air-Referenced Velocity Reports (ARV) must be supported, it is quite possible that those reports will be desired under operational conditions (such as coming in on final approach to assist in vortex modeling) or perhaps at all times at low rates (to assist in wind modeling, or to be an available backup if ground-based velocity data is lost). The 1090 ES system is limited to broadcasting only two velocity squitters per second. Under nominal conditions, these squitters are of subtypes 1 or 2 which convey ground-based velocity information. Therefore, a DO-260A system cannot support ARV reports under nominal conditions. To allow some air-referenced data to be broadcast supporting the ARV report under nominal conditions, an on-condition message needs to be defined so that air-referenced data can be broadcast at a rate lower than State Vector messages when those SV messages are broadcasting ground-based velocity data.	Define an ARV Report On-Condition Message that will support the data elements of the ARV report as defined in §3.4.6 of DO-242A. **WG-3 Response: Agreed with Modification** See Barhydt Summary Comments #66 and #67

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	#	Author				
46	5	Stuart Searight	2.2.3.2.7.2.3.8	116	B2 Low CC Code: Announcing that equipment is of class B2 Low says that it is operating at less than 70W, but does not say how low the power is, or how limited the operational range is. Is it acceptable – or worse unsafe – to have these ADS-B messages broadcast without any known acquisition or update performance associated with them? It has been demonstrated at WG3 meetings that the 70 W requirement is overly stringent to meet the 5 NM operational ranges for A/V operating on an airport surface, but WG3 did not have the time or resources to definitively determine what the minimum power might be to meet the 5 NM requirement. Perhaps it would be of greater value to the overall ADS-B environment to define B2 Low as equipment that operates at less than 70 W, but has been demonstrated to meet acquisition and update requirements at ranges of at least 5 NM under normal interference conditions for any airport at which the equipment will be deployed.	Define B2 Low equipment to be equipment that does not meet the DO-260A 70 W RF Peak Output Requirements, but does met the DO-242A 5 NM acquisition and update requirements for surface operations. **WG-3 Response: Agreed with Modification** WG-3 proposes to add a note to 2.2.2.2.10.2 stating that: **"***It is noted that the 70 W minimum RF peak output power requirement for Class B2 equipment is overly stringent to meet the 5NM operational range required for airport surface operations in DO-242A. Future revisions of these MOPS may reduce the minimum power output requirement on B2 equipment to better reflect the 5NM operational range.*" **Done**
47	6	Stuart Searight	2.2.3.2.7.7	125	Reserved Type 27 Messages: While it is appropriate not to define the messages supporting Trajectory Change Reports in this section, it might be useful to the reader to reference the work found in Appendix O.	Add a note to this section stating the following: *While no messages supporting Trajectory Change (TC) reports are defined in this version of these MOPS, a possible approach to the broadcast of this information is described in Appendix O, "Accommodation of Trajectory Change Reporting."* **WG-3 Response: Agreed** **Done**
48	7	Stuart Searight	2.2.3.3.1.1	126	Editorial: Section Title is not capitalized.	Capitalize appropriate words in section title. **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
49	8	Stuart Searight	2.2.3.3.1.2	126	Editorial: Section Title is not capitalized.	Capitalize appropriate words in section title. **WG-3 Response: Agreed** **Done**
50	9	Stuart Searight	2.2.8.1.4	180	Editorial: Since Subfields of Report Time of Applicability are in a table (Table 2.2.8.1.4), they should not be enumerated.	Remove enumeration within subfield column of Table 2.2.8.1.4. **WG-3 Response: Agreed** **Done**
51	10	Stuart Searight	2.2.8.2.11 2.4.8.2.11	200 630	Operational Mode: The 2nd paragraph of this section appears to be an unwanted left-over from DO-260. The paragraph reads as follows: When valid "Operational Mode" data is not available, the Flight Mode Specific Data sent to the user application shall be set to ALL ZEROs." This sentence is found in §2.2.8.2.10 of DO-260 which was for Flight Mode Specific Data, however, that field is now only a "Reserved" field due to corresponding changes in DO-242A. At best it is redundant, since the (Reserved for) Flight Mode Specific Data is always sent to ALL ZEROs, regardless of the availability of OM data. At worst, this sentence is misleading since it shows a correlation between the value of Flight Mode Specific Data and OM Codes, which is no longer the case in DO-260A	Delete 2nd paragraph from §2.2.8.11 and make appropriate changes in 2.4.8.2.11, which includes deletion of same sentence from "Purpose/Introduction" and possible deletion of step 4. **WG-3 Response: Agreed** **Done**
52	11	Stuart Searight	App. F (R2.37)	F-11	The section defining messages supporting Target State reports is not cited.	Add §2.2.3.2.7.1, "Target State and Status Message" to list of referenced sections. **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
53	12	Stuart Searight	App. F (R2.38)	F-11	Since no messages have been defined in DO-260A supporting TC reports, this requirement is not met. (This was done at the direction of plenary at the time of the approval of DO-242A.) (See also Searight Comment 13.)	Remove the referenced sections and place the following in the Notes column: At the direction of the SC-186 plenary, messages support Trajectory Change reports were not defined for this version of these MOPS." <<If this resolution is not accepted, the references sections should be corrected by replacing §2.2.3.2.7.1 with §2.2.3.2.7.7 and Appendix O.>> **WG-3 Response: Agreed** **Done**
54	13	Stuart Searight	App. F (R2.39)	F-11	Since no messages have been defined in DO-260A supporting TC reports, this requirement is not met. (This was done at the direction of plenary at the time of the approval of DO-242A.) (See also Searight Comment 12.)	Remove the referenced sections and place the following in the Notes column: "At the direction of the SC-186 plenary, messages supporting Trajectory Change reports were not defined for this version of these MOPS." **WG-3 Response: Agreed** **Done**
55	14	Stuart Searight	App. F (R3.31)	F-18	Now that Appendix P is complete, the Notes column for this row should be updated with specific estimated performance for 1090 ES system in LA2020.	Document that in the LA2020 environment, it appears that A2 equipment will not meet acquisition and update requirements for State Vector at 40NM, and that A2 and A3 equipment will not meet acquisition and update requirements of Target State Reports at 40 NM, with the exception of A3-A3 communications with 24K fruit. **WG-3 Response: Agreed with Modification** Change the comment column to read **"***Performance results for LA2020 are summarized in Appendix P, Tables P-6 and P-7."* **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
56	15	Stuart Searight	App. F (R3.111)	F-33	For MASPS requirement R3.111A-C (IDENT OM Code), there should be a reference to DO-181C, §2.1.7 to show that there is a requirement for a Flight Crew Control to set this field at the request of ATC. Also, §2.2.8.2.11 is cited, but that section does not address this requirement.	Delete reference to §2.2.8.2.11 "Mode States Report Operational Mode" and add a reference to DO-181C, §2.1.7 "Flight Crew Control Functions. **WG-3 Response: Agreed** **Done**
57	16	Stuart Searight	O.3	O-6	The title of Table O-3 and title of header row above the TC message types is confusing and misleading. At first read it appears that the Table is showing elements in the TC Report, not which elements are conveyed in different TC messages. Too much is trying to be said in the header row for the 3 message types and is confusing. The suggested resolution, if done together, stress that the table is about the messages which support the TC report, and that the three columns represent different SUBTYPE values for the Target State and Status Messages.	Change the Table title to the following: "Table 0-3: Bit Allocation for Messages Supporting Trajectory Change Reports." Change Header row for 3 Message Types to the following: "Target State and Status Message SUBTYPEs." **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
58	17	Stuart Searight	Table O-3	O-6	Appendix O does not specify coding for each TC message type, which is appropriate. However, since it does suggest that the 1090 ES ADS-B system will need to segment TC Report data into Basic and Supplemental Messages, some discussion on how these messages will be managed is needed. Appendix O states that some aircraft will only be able to support the data contained in the Basic Message and therefore only transmit those messages, while other, more sophisticated aircraft might be transmitting both the Basic and Supplemental Messages. It will be important on the receive side to know, upon reception of a TC Basic Message, if that is all the long-term intent data being broadcast from that aircraft, or if more is forthcoming in a TC Supplemental Message.	The easy fix for this would be to have a 1-bit field in the TC Basic Message conveying whether or not TC Supplemental messages are being broadcast or not. However, there are no bits available, as the proposed TC Basic Message used all 56 ME bits. This means some encoding scheme might be best used to convey whether or not TC Supplemental Messages are being broadcast. **WG-3 Response: Agreed with Modification** After discussion, a new paragraph was inserted after Table O-2 in §O.3 stating that: ***"****If the TC Basic Message can support the minimum application requirements for the TC Report, and can therefore be transmitted without an associated TC Supplement Message, a means conveying whether or not TC Supplemental Messages are being broadcast must be provided. (Possible means include coding schemes within TC Basic Messages, or within Operational Status Messages.)*" **Done**
59	18	Stuart Searight	P.2.3.2	P-10	Editorial: Listed reports should be done so consistently.	In 2nd sentence of 1st paragraph, change to read as follows: " . . . acquisition of the State Vector, Mode Status, and Target State reports . . ." **WG-3 Response: Agreed** **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
60	19	Stuart Searight	P.2.3.2	P-17	The third (and last) paragraph of this section does not fit on page P-10 with the rest of P.2.3.2 and therefore gets pushed back so that it appears after Figures P-2 through P-13. This is a most unfortunate pagination occurrence because this is the paragraph in which the 10 miles bins and appropriate interpretation of the APL results is found. By the time the reader's eyes see the paragraph, they have already looked at all of the results.	Force pagination to include all three paragraphs of P.2.3.2 prior to the figures. (Either use "Keep with Next", or reduce line spacing between 2nd level bullets in P.2.3.1 on P-9, allowing the paragraph to fit onto P-10. **WG-3 Response: Agreed with Modification** Decided to leave the 3rd paragraph where it is after the figures, but inserted the sentence**: "***The 95-95 metric was calculated by placing the aircraft in range bins of ten (10) NM width and plotted in the form of histograms*" into the 2nd paragraph prior to the Figures. **Done**
61	20	Stuart Searight	P.2.3.2	P-17	The third (and last) paragraph of this section discusses how the reader must interpret APL results due to the use of the 10 mile bins. This discussion is written in context of the summary table (Table P-1). It would be of more benefit, however, to frame this discussion on how to interpret the APL figures. Further, this discussion should be it's own paragraph, and expanded upon.	1. Find a more appropriate place for the 1st sentence of this paragraph ("Recall that the LA2020 scenario includes 2694 aircraft and 50 ground vehicles transmitting on 1090 ES.") 2. Move second sentence to a new paragraph AFTER the figures and before Table P-1. (The results for LA2020 shown in Figure P-2 through Figure P-13 are summarized in Table P-1. 3. Expand on the last two sentences of the paragraph to further clarify interpretation of APL results. **WG-3 Response: Withdrawn** With the resolution of Searight Summary Comment #60.

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
62	21	Stuart Searight	P.3.1.3	P-24	Editorial: The description of 2 scenarios is different from the rest of this appendix and is therefore confusing. For consistency, this should discuss two different cases of the LA2020 scenario.	Make following changes to P.3.1.3: The pulse-level simulation was run for ~~two scenarios~~ the LA2020 scenario with two different cases of fruit levels representing different interference environments for future higher aircraft densities. The ~~scenario~~ first case, called "LA2020-[24k]," has 24,000 Mode A/C fruit per second, as described above. The second, more severe ~~interference scenario~~ case, called "LA2020-[30K]," has 30,000 Mode A/C fruit per second, with the same Mode S interference as in LA2020-[24k]. **WG-3 Response: Agreed** **Done**
63	22	Stuart Searight	P.3.2.2	P-30	Editorial. Change "surveillance update time" to "State Vector update time"	Change "surveillance update time" to "State Vector update time" **WG-3 Response: Agreed** **Done**
64	23	Stuart Searight	P.3.2.3 P.3.2.4	P-31	It seem that the natural ordering of material would dictate that these sections be switched so that the ordering is A3-A3, A3-A2, A2-A2.	Switch ordering of these two sections. **WG-3 Response: Rejected** Left as-is.
65	24	Stuart Searight	P.3.4	P-34	This section only says that the same process used for LA2020-[24K] was also used for LA2020-[30K]. This is already understood by reading the rest of the Appendix.	Delete this section. **WG-3 Response: Agreed with Modification** Agreed to leave the paragraph in, but to specifically reference the figures P-21 and P-22. **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
66	1	Richard Barhydt	1.2.7.4	11	**NON-CONCUR –** This section says that air referenced velocity (ARV) reports are only generated when ground referenced velocity is not broadcast in the Airborne Velocity Message. This statement precludes the use of ARV for future applications that may require simultaneous use of air and ground referenced velocity from a transmitting aircraft. Although the ADS-B MASPS (DO-242A) does not currently stipulate broadcast requirements to support ARV reports, ARV information may be needed to support future applications such as in-trail spacing and separation assurance. In these cases, ARV would be used along with ground-referenced velocity in order to extract wind information encountered by the transmitting aircraft. A more detailed discussion of ARV information and its supporting applications is provided in Appendix Q of the ADS-B MASPS. It is expected that future versions of the ADS-B MASPS will give conditions requiring the support of ARV reports even when ground referenced velocity is available. When these changes are made, a backward compatibility problem will exist for DO-260A compliant systems.	The second sentence of this section should be deleted or changed to allow broadcast of ARV information even when ground referenced velocity is available. **WG-3 Response: Agreed to revise §1.2.7.4 as follows:** The Air Referenced Velocity Report (2.2.8.3.2) contains velocity information that is required from only certain classes of ADS-B equipped aircraft. This report is only generated when air referenced velocity information is being broadcast in the Airborne Velocity Message (2.2.3.2.6). *Note: Air referenced velocity messages may be received from airborne aircraft that are also broadcasting messages containing ground referenced velocity information. ADS-B Receiving Subsystems conformant to these MOPS are required to receive and process ground referenced and Air Referenced Velocity Messages from the same aircraft and output the corresponding reports. Although not required in these MOPS, future versions of these MOPS will specify under what conditions both ground referenced and air referenced velocity would be transmitted. This is intended to provide compatibility with anticipated future requirements for the transmission of both types of velocity information.* Additional Test Procedure inserted into 2.4.8.1.17 to verify that position is not updated with the receipt of Air Referenced Velocity. **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
67	2	Richard Barhydt	2.2.3.2.7	101	**NON-CONCUR –** It appears that the MOPS can only support ARV information when ground referenced velocity is unavailable. If so, this design does not allow for future applications that may have a need for air and ground referenced velocity from the same aircraft.	The resolution to this issue should enable broadcast of ARV information even when ground referenced velocity is available. Possible solutions may include: - Addition of an ARV on-condition message that would support ARV reports. This on-condition message would be required to be transmitted under conditions specified by Section 3.4.6.1 of the ADS-B MASPS (DO-242A). Note that this change would require an appropriate correction to Sections 2.2.5.1.15 through 2.2.5.1.17 (ADS-B Transmission Device Data Processing and Message Formatting for ARV information). - Temporary substitution of ARV information (Velocity Subtypes "3" and "4") to replace the ground referenced velocity (Velocity Subtypes "1" and "2") in the Airborne Velocity message. Other solutions may also be possible. **WG-3 Response: Same response as in Barhydt Summary Comment #66**
68	1	Mark Schneider	2.2.3.3.2.12	137	The current requirement to stop transmitting if input data is not available for a period of 60 seconds is in conflict with section and 2.2.3.2.3.1.3.2, which is meant to allow multilateration systems to track aircraft and vehicles on the ground regardless of the status of their GPS data source. The change to 2.2.3.2.3.1.3.2 is documented in Working Paper 14-19.	I recommend ending the **shall** with "...except that transmission termination of Surface Position Messages does not apply to Non-Transponder Devices on aircraft that are on the surface, or on surface vehicles." **WG-3 Response: Agreed with Modification Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
69	2	Mark Schneider	2.2.3.3.2.3.d	133	Reference Jerry Anderson Comment #6 *Replace 2.2.3.3.2.3.d with, "If the transmission device is transmitting a NIC or NAC$_P$ less than 8, it shall use the "Low" transmission rate."*	I recommend not accepting Jerry's recommendation. The existing requirement may need to be clarified, but the suggested change is not consistent with the intent of the requirement. For non-transponders on the surface, we should allow the high rate (2/second) so that if the vehicle is moving, multilateration systems can track it. This would be consistent with the change to 2.2.3.2.3.1.3.2, which was agreed upon after reviewing Working Paper 14-19. **WG-3 Response: Agreed** **Done**
70	3	Mark Schneider	Appendix A.1.4.3.2.1	A-16	J. Loewe suggests Change "close to zero" to "below 40 knots"	I recommend not accepting J Loewe's recommendation. "Close to zero" will be different depending on what the navigation sensor is capable of doing. The decision of how close is too close should be made by the manufacturer after considering the specifics of his implementation. **WG-3 Response: Agreed** **Done**
71	4	Mark Schneider	2.2.3.2.7.2.3.8	116	**With respect to the Stuart Searight Comment #5 concerning the B2 Low CC Code:**	I recommend not accepting Stuart's recommendation. If we do redefine B2-Low as meeting power requirements but don't use a value, this becomes a very subjective and hard-to-test requirement. Sensis would support a 10-Watt requirement for B2 Low. **WG-3 Response: Withdrawn** Searight comment withdrawn

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
72	5	Mark Schneider	2.2.3.2.1.7	45	Editorial Should the first sentence of this section contain a **shall**?	Start the sentence with "The PI field **shall** be a…" **WG-3 Response: Agreed** **Done**
73	6	Mark Schneider	2.2.3.2.4.8.1	74	Editorial The requirement incorrectly refers to the "airborne" longitude position.	Change to "surface longitude position" **WG-3 Response: Agreed** **Done**
74	7	Mark Schneider	P.4	P-38	Minor Point The difference between the two fruit rates for low-density airspace is not clear.	Consider Working Paper submitted by Bill Harman to add a single sentence to clarify this point. **WG-3 Response: Rejected** See Harman Summary Comment #20
75	8	Mark Schneider	P.3.3	P-33	Minor Point A small change in performance at shorter ranges can cause a dramatic change in TSR range performance.	Consider Working Paper submitted by Bill Harman to revise this section. **WG-3 Response: Agreed** See Harman Summary Comment #27 and WG-3 Summary Comment #77

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
76	1	Working Group 3	Appendix P.4	P-37	As per agreement during a WG-3 Teleconference, a paragraph was to be generated by Bill Harman and Larry Bachman and reviewed by George Ligler describing the reasons for the differences in several lines of Tables P-6 and P-7 describing simulation results. The agreed text is as follows: "The performance results reported in Appendix P were derived from two independent evaluations, one by APL and the other by LL. Examination of Tables P-6 and P-7 shows (only) three differences in simulated performance results provided by APL and LL that impact the determination of whether particular RTCA DO-242A requirements are projected to be met by the 1090 MHz Extended Squitter system in the LAX 2020 air traffic scenario (Table P-6, A2 transmitter and A2 receiver at 24,000 Mode A/C fruit; Table P-7, A3 transmitter and A3 receiver at 30,000 Mode A/C fruit; and Table P-7, A3 transmitter and A2 receiver at 24,000 Mode A/C fruit). A significant effort was made to understand the reason for any differences between the results reported by each evaluation. The APL and LL evaluation techniques, while using similar assumptions on, for example, probability of correct reception of a single Extended Squitter as a function of received signal power, use different simulator architectures and, for A3 receivers, a different sampling rate. These differences, in conjunction with uncertainties inherent in the simulation processes, are the likely source of the differences in the values for update ranges obtained."	**WG-3 Response:** Insert the agreed upon text after the existing text and prior to the "References." **Done**

#	Original Comment		Section	Page	Comment	Suggested Resolution
	#	Author				
77	2	Working Group 3	Appendix P.4	P-37	After review of William Harman Comment #8 and his proposed replacement of paragraph P.3.3, WG-3 agreed with the comment and the proposed resolution and further recommends the insertion of a sentence in the Summary Paragraph P.4 to further explain how relatively small differences in performance can result in significant differences in the range at which the MASPS TSR requirement is satisfied.	**WG-3 Response:** Suggest inserting the following sentence as the next to last paragraph in P.4: "As described in §P.3.3, relatively small variations in predicted TSR performance may result in significant differences in the ranges at which the MASPS TSR updates rates are satisfied." **Done**
78	3	Working Group 3	Appendix A Table A-1	A-4	The Aircraft Operational Status Message must remain assigned to register 6,5 (as it was in DO-260) rather than change to register 6,3 for conformance to the ICAO SARPs (as if appears in the draft DO-260A).	**WG-3 Response:** Change the row in Table A-1 that shows "63_{16} Aircraft Operational Status" to "$63_{16} – 64_{16}$ Reserved for Extended Squitter" Insert a row that shows "65_{16} Aircraft Operational Status" Change the last row in Table A-1 from "$64_{16} – 6F_{16}$" to "$66_{16} – 6F_{16}$" **Done**
79	4	Working Group 3	A.2.4.4 Figure A-15 Figure 2.2.17.3.4	A-67 A-73 246	A review of the draft TIS-B MASPS indicates that the current 1090 TIS-B formats do not accommodate geometric height, vertical rate type baro/geo, and true/magnetic heading.	**WG-3 Response:** We propose a change to Figure A-15 to make provision for this information. This change also requires a modification to Figure 2.2.17.3.4 to reflect the insertion of the "Geo" flag in "ME" bit position 36 and the change in transmission of "ME" bits 48 through 56 as shown in the attachment to this comment in the proposed Figure A-15. Also the reference at the end of §A.2.4.4 also changes from "7A-14" to "Figure A-15." **Done**

Because the material in section P.3.3 is oversimplified, I offer the following rewording. Making this change is not critical, but it might be helpful to some readers.

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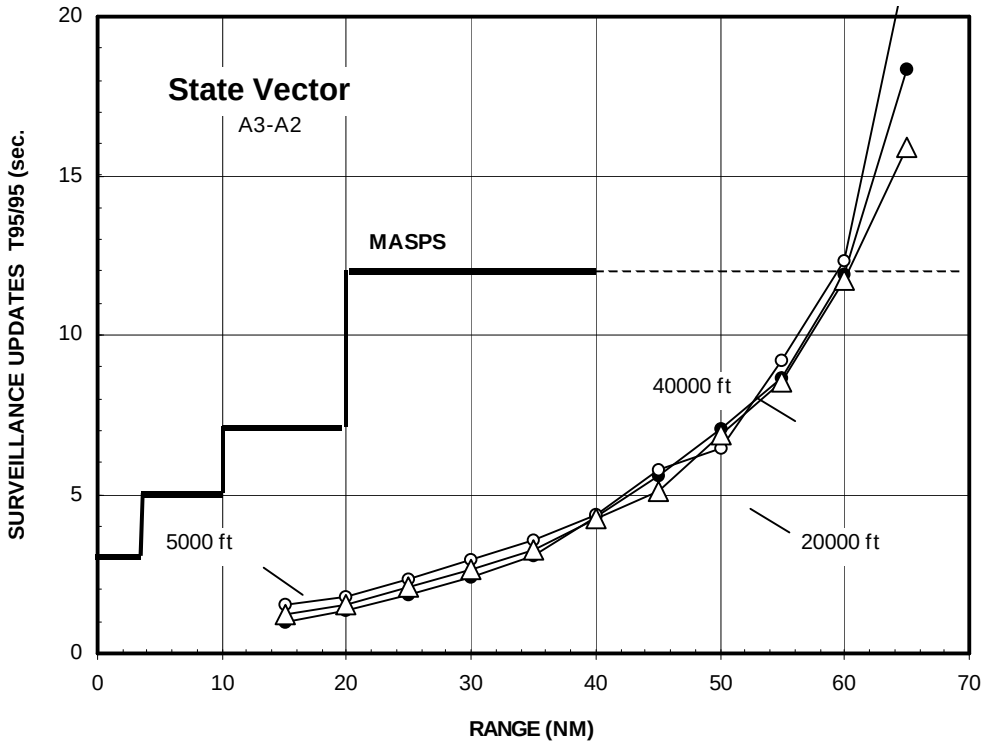
P.3.3. Effects of Altitude

In the normal formulation, the two aircraft are considered to be at approximately the same altitude, and therefore the elevation-angle portion of the antenna gain model was not used (only the statistical portion was used). For an additional study of altitude effects, the formulation was changed so that the transmitting aircraft has a specific altitude (a parameter entered by the user) while the receiving aircraft is at the fixed altitude of 40,000 feet. Therefore the results depend on the transmitter altitude. The TLAT model of aircraft antenna gain as a function of elevation angle was used in this study [Ref. P-1].

The results for several values of transmitter altitude are shown in Figure P-25 and Figure P-26. The results indicate that performance is somewhat degraded when the transmitter is changed from 40,000 feet to 5000 feet. The degradation is more pronounced at shorter range, which seems reasonable because of the steeper elevation angles. Beyond 50 NM, performance is not changed significantly.



<u>Figure P-25:</u> Effects of Transmitting Aircraft Altitude (A3-A2, LA2020-[24k]) on State Vector

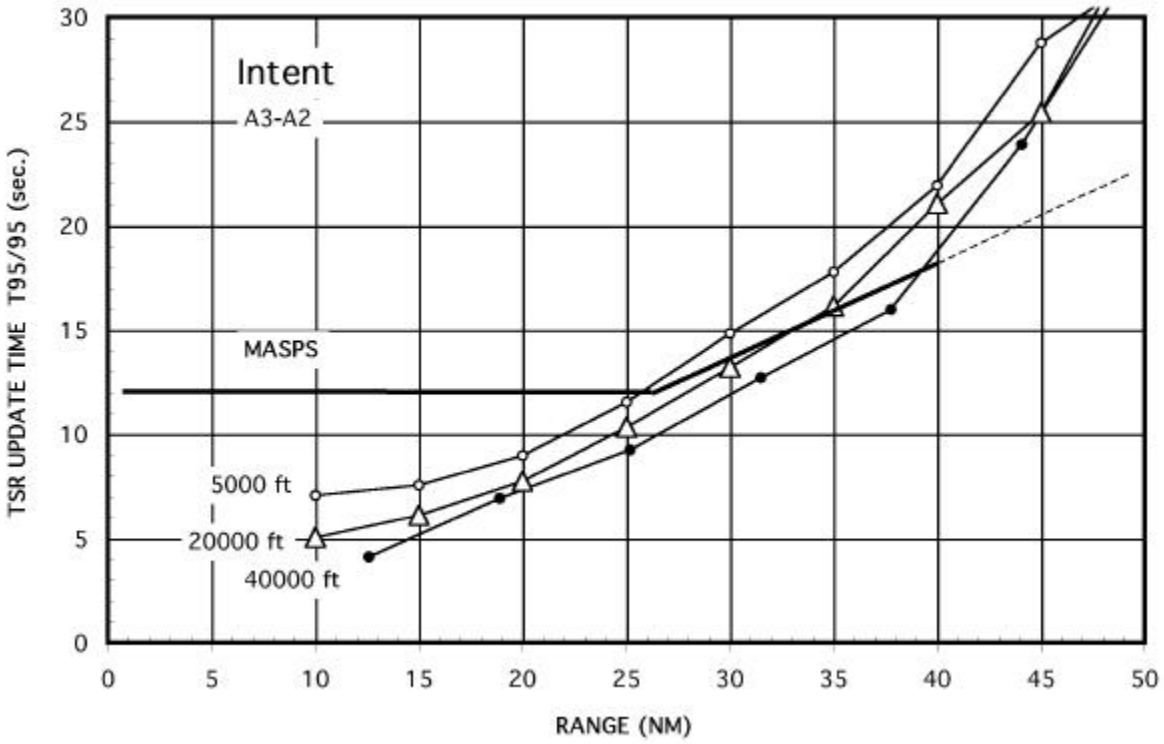


Figure P-26: Effects of Transmitting Aircraft Altitude (A3-A2, LA2020-[24k]) on TSR Update Rate

Altitudes marked in the figure apply to the transmitting aircraft.
The receiving aircraft is at 40,000 feet.

Looking at intermediate results from the simulation, one can see several reasons why altitude would not be expected to have much effect at long range. For long range, the elevation angle change is small. For example, for range of 100 NM and transmitter altitude of 5000 feet, the elevation angles are +/-3.3 degrees. According to the TLAT antenna gain model, this causes a drop by only 1.1 dB for one antenna and a boost by 1.0 dB for the other. The effects are small and nearly identical.

Figure P-26 indicates that the slope of the performance curves is similar to the slope of the TSR requirement. As a result, the relatively small degradation in TSR performance in this figure causes the MASPS intersection point to drop more dramatically. Although the MASPS requirement is not strictly met beyond that point, the performance is only a few seconds different from the requirement.

In conclusion, the results from the normal runs, in which altitude differences were not used, have been shown to be accurate at long ranges, regardless of the actual altitude of the transmitting aircraft. The results indicate that performance is not very sensitive to transmitter altitude between 20,000 feet and 40,000 feet, although sensitivity increases for very low transmitters.

A review of the draft TIS-B MASPS indicates that the current 1090 TIS-B formats do not accommodate geometric height, vertical rate type baro/geo, and true/magnetic heading. We propose a change to Figure A-15 to make provision for this information. This change also requires a modification to Figure 2.2.17.3.4 to reflect the insertion of the "Geo" flag in "ME" bit position 36 and the change in transmission of "ME" bits 48 through 56 as shown in proposed Figure A-15, which is attached. Also the reference at the end of §A.2.4.4 also changes from "7A-14" to "Figure A-15."

A.2.4.4 Airborne Velocity Message

The TIS-B Airborne Velocity ME field will be formatted as specified in ~~the 7A-14~~Figure A-15.

Note: *Additional details are specified in the following paragraphs.*

A.2.4.4.1 Subtype Field

Only Subtypes 1 and 2 will be used for the TIS-B Airborne Velocity Message. Subtype 1 will be used for velocities under 1000 knots and Subtype 2 will be used for aircraft capable of supersonic flight when the velocity might exceed 1022 knots.

The supersonic version of the velocity coding will be used if either the east-west OR north-south velocities exceed 1022 knots. A switch to the normal velocity coding will be made if both the east-west AND north-south velocities drop below 1000 knots.

A.2.4.4.2 ICAO/Mode A Flag (IMF)

This one-bit field (bit 9) will indicate the type of identity associated with the aircraft data reported in the TIS-B message. Coding is specified in §A.2.4.1.1.

Figure A-15: TIS-B Airborne Velocity Messages
(Subtypes 1 and 2: Velocity Over Ground)

1	MSB		**1**	
2			**0**	
3	FORMAT TYPE CODE = 19		**0**	
4			**1**	
5	LSB		**1**	
6	SUBTYPE 1	0	SUBTYPE 2	0
7		0		1
8		1		0
9	IMF (See §A.2.4.4.2)			
10	MSB			
11	Navigation Accuracy Category for Position (NAC_P)			
12	(§A.1.4.10.7)			
13	LSB			
14	DIRECTION BIT for E-W velocity **(0=East, 1=West)**			
15	EAST-WEST VELOCITY (10 bits)			
16	NORMAL : LSB = 1 knot		SUPERSONIC : LSB =4 knots	
17	All zeros = no velocity info		All zeros = no velocity info	
18	Value	Velocity	Value	Velocity
19	1	0 kts	1	0 kt
20	2	1 kt	2	4 kt
21	3	2 kt	3	8 kt
22	-	-	-	-
23	1022	1021 kt	1022	4084 kt
24	1023	>1021.5 kt	1023	> 4086kt
25	DIRECTION BIT for N-S velocity **(0=North, 1=South)**			
26	NORTH-SOUTH VELOCITY (10 bits)			
27	NORMAL : LSB = 1 knot		SUPERSONIC : LSB =4 knots	
28	All zeros = no velocity info		All zeros = no velocity info	
29	Value	Velocity	Value	Velocity
30	1	0 kts	1	0 kt
31	2	1 kt	2	4 kt
32	3	2 kt	3	8 kt
33	-	-	-	-
34	1022	1021 kt	1022	4084 kt
35	1023	>1021.5 kt	1023	> 4086kt

36	~~Reserved (1 bit)~~GEO=0	GEO=1
37	SIGN BIT FOR VERTICAL RATE: 0 = up, 1 = down	SIGN BIT FOR VERTICAL RATE: 0 = up, 1 = down
38	VERTICAL RATE (9 bits)	VERTICAL RATE (9 bits)
39	All zeros – no vertical rate information, LSB = 64 ft/min	All zeros – no vertical rate information, LSB = 64 ft/min
40		
41		
42		
43		
44		
45		
46		
47	NIC Supplement (See §A.1.4.10.6)	NIC Supplement (See §A.1.4.10.6)
48	Navigation Accuracy Category for Velocity (NAC_V)	Reserved (1 bit)
49	(See §)	DIFFERENCE SIGN BIT (0 = above baro, 1 = below baro alt))
50		GEOMETRIC HEIGHT DIFFERENCE FROM BARO. ALT. (7 bits) (
51	Surveillance Integrity Level (SIL)	Same coding as Airborne Velocity Message
52	LSB (See §)	
53	Reserved	
54	Reserved	
55	Vertical Rate Type: 0=baro, 1= geo	
56	True/Magnetic Heading: 0= true, 1= magnetic	