MASPS for ADS-B Rev. A

Tracking Information (committee secretary only)	
Change Issue Number	35
Submission Date	5/16/01
Status (open/closed/deferred)	Rev. A – CLOSED
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Short Title for Change Issue:	Delete or change note 7 of Table 3-4 to assure that this note does not change or supercede the requirements defined in Table 3-4.

MASPS Document Reference:		Originator Information:	
Entire document (y/n)		Name	William Harman
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Paragraph number(s)		E-mail	harman@ll.mit.edu
Table/Figure number(s)	Table 3-4	Other	

	Proposed Rationale for Consideration (originator should check all that apply):
	Item needed to support of near-term MASPS/MOPS development
	DO-260/ED-102 1090 MHz Link MOPS Rev A
	ASA MASPS
	TIS-B MASPS
	UAT MOPS
	Item needed to support applications that have well defined concept of operation
	Has complete application description
	Has initial validation via operational test/evaluation
	Has supporting analysis, if candidate stressing application
	Item needed for harmonization with international requirements
	Item identified during recent ADS-B development activities and operational evaluations
X	MASPS clarifications and correction item
	Validation/modification of questioned MASPS requirement item
	Military use provision item
	New requirement item (must be associated with traffic surveillance to support ASAS)

Nature of Issue:		Editorial	X	Clarity		Performance		Functional

Issue Description:

Table 3-4 provides a summary of the main technical requirements for ADS-B. In particular, row 4 gives the required values for Nominal Update Period. This row refers to Note 7, which provides a more general statement that combines update period and reception probability. This note was originally intended to provide a flexible way of understanding the requirements in the table.

When the MASPS was developed, an extensive study was done to show the effects of update rate and report probability. This work, which was done mostly by J. Hammer and W. Harman is documented in MASPS Appendix J. Simulation was used for this study, in which ADS-B was modeled simplistically as a periodic transmission with a fixed reception probability. For long-range applications, for example, ADS-B was modeled as a transmission every 12 seconds, with reception probability 0.95. Of course it was recognized that some possible implementations of ADS-B would not follow the simplistic model. Extended Squitter, for example, has a higher transmission rate and lower reception probability. Note 7 was then added to Table 4-3 to indicate that such differences in rate and probability were allowable.

Issue Description (continued):

The problem is that the formula in Note 7 is inconsistent with the values in the table. For example, using the example of long-range surveillance, where the Nominal Update Period in Table 3-4 is 12 seconds, using the formula in Note 7 leads to the following possible values of T and P:

T	P
0.5 sec.	0.09
3 sec.	0.44
12 sec.	0.90

Note that this formula would allow a periodic ADS-B design to transmit at 12 second periods with reception probability of only 90 percent, rather than requiring 95 percent as is stated directly in the Table. This inconsistency was originally not considered to be serious, because it was though that all readers would realize that the values in the Table should prevail.

Originator's proposed resolution if any:

It was noted more recently that some readers of the MASPS are using the values from Note 7, rather than the values from the Table. Therefore, I propose that we correct this inconsistency, and make it clear that the values in the Table are the requirements. One way to correct the inconsistency would be to eliminate Note 7. Alternatively it would be possible to retain Note 7, but change the formula as follows.

7. *Acceptable combinations of report update period (T) and update probability (P) are given by the formula (1 – P)^(TU/T) <= 0.05 where TU is the Nominal Update Period given in the table.*

Working Group 6 Deliberations:

May 24, 2001: The ad hoc group agreed that this Issue Paper will be addressed in Revision A of DO-242.

July 19, 2001: This Issue Paper received much discussion at the July WG6 meeting (see minutes). The final conclusion for a resolution to IP35 at this meeting was to modify Note 7 by removing the formula and explaining that the 99th percentile received report update period is normative. And that other update period/receipt probability ratios could be acceptable subject to analysis. Jonathan Hammer and Steve Heppe were given the action item to find a resolution agreeable to both.

August 30, 2001: It was reported that an agreeable solution could not be found between Jonathan and Steve. They will continue to try to find a solution that makes the requirements consistent and eases the 99% requirement from that defined in Table 3-4. Bill Harman, author of this IP, will also be consulted.

October 26, 2001: At the October WG6 meeting, Jonathan Hammer reported on efforts to resolve this Issue Paper to the satisfaction of Steve Heppe, Bill Harman, and himself. (242A-WP-9-07a) At the time of the meeting, Steve Heppe had not yet responded to Jonathan's final proposal to change Note 7. WG6 reviewed Jonathan's proposed note and – after some minor word-smithing – agreed that note 7 would be changed as proposed by Jonathan, unless Steve objects strongly and with another acceptable solution. Stuart will summarize the final decision of the group and send it to Steve and Bill for final comments [AI 9-14].

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Working Group 6 Deliberations (continued):

October 26, 2001 (continued):

The note agreed to by WG6 reads as follows:

"These standards represent best engineering judgment at the time of publication. Deviation from these standards may be acceptable provided that the applicant demonstrate that all required applications are supported. These requirements will receive additional validation during development of the ASA MASPS."

December 2001 – January 2002: AI 9-14 lead to another round of discussions on this topic. The note proposed – and tentatively agreed to – at the WG6 meeting in October was objected to because they felt it was an "empty" note that merely pushed this issue off to the ASA MASPS and/or a future revision of DO-242.

While it was agreed to by all parties that the original Note 7 should be deleted, it was all agreed to that the update rate requirements for non-ACM use at short ranges were set somewhat arbitrarily and were too stringent. Therefore, a new alternative for Note 7 was proposed and agreed to. It will be referenced in the column labeled "R < 10 NM"[1] and read as follows:

"Requirements for airborne conflict management (ACM) are under development. The 3 second update requirement is the minimum update period required to support ACM for aircraft pairs within 3 nmi and 6000 feet vertical separation that are converging at a rate of greater than 500 feet per minute vertically or greater than 6000 feet per minute laterally. Update rate requirements are once per 5 seconds (95%) for aircraft pairs that are not within these geometrical constraints, i.e., aircraft pairs that are diverging, and for applications other than ACM."

February 1, 2002: This Issue Paper was discussed during the January 2002 WG6 meeting. After agreeing that the new note being proposed to replace note 7 was addressing a separate issue than the original note 7's intent and was out of scope of this Issue Paper. Therefore, it was agreed that the resolution of this Issue Paper will be the deletion of Note 7. AI 11-6 was given to Steve Heppe to author a new Issue Paper requesting the relaxation of the 3 second update rate at ranges less than 10 nmi under certain constraints. The resolution of that Issue Paper (IP56) will be the one agreed to by WG6 at the January 2002 meeting based on the alternative note previously discussed as part of this Issue Paper. Further, to assure the note that will resolve IP56 is not mistaken as a replacement for note 7 in DO-242, the note will be placed at the end of the Table 3-4 notes and be numbered accordingly.

Footnote 1: The columns of Table 3-4 are to be relabeled as per Issue Paper 46

Working Group 6 Final Resolution:

The final resolution of this Issue Paper is the deletion of the DO-242 Note 7 of Table 3-4 for the draft DO-242A delivered to RTCA March 4, 2002.

Note: As part of the deliberations of this IP's resolution, it was agreed to have IP56 authored which requests a relaxation of the 3 second update rate at ranges less than 10 nmi under certain constraints. The resolution IP56 will be a note similar to that which was previously discussed in conjunction with this Issue Paper.

The new note which will be added to the draft DO-242A to resolve Issue Paper 56 reads as follows:

> "Requirements for applications for ranges less than 10 nmi are under development. The 3 second update requirement is the minimum update period required to support ACM for aircraft pairs within 3 nmi and 6000 feet vertical separation that are converging at a rate of greater than 500 feet per minute vertically or greater than 6000 feet per minute laterally. Update rate requirements are once per 5 seconds (95%) for aircraft pairs that are not within these geometrical constraints, such as aircraft pairs that are diverging. Requirements for future applications, however, may differ from these requirements."

The above note will be referenced in Table 3-4 in the in the column that is to be labeled "R < 10 NM" as per the agreed upon resolution of IP46 for the rows defining the 95% and 99% requirements.