

# MASPS for ADS-B Rev. A

Tracking Information (committee secretary only)	
Change Issue Number	28
Submission Date	3/21/01
Status (open/closed/deferred)	CLOSED
Last Action Date	5/24/01

Short Title for Change Issue:	Air-referenced parameters should be excluded from normal/default SV transmissions.
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MASPS Document Reference:		Originator Information:	
Entire document (y/n)		Name	Stephen Heppe
Section number(s)		Phone	703 589-1522
Paragraph number(s)	2.1.2.2; and 3.4.3.1	E-mail	Steveheppe@adsi-m4.com
Table/Figure number(s)	Table 2-2, Table 3.5	Other	

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

Nature of Issue:	<input type="checkbox"/> Editorial	<input checked="" type="checkbox"/> Clarity	<input type="checkbox"/> Performance	<input type="checkbox"/> Functional
<u>Issue Description:</u>				
<p>The MASPS are unclear with regard to the treatment of air-referenced parameters (airspeed and heading). Paragraph 2.1.2.2 (State Vector) does not reference either airspeed or heading. Table 2-2 does not list either airspeed or heading. Paragraph 3.4.3.1 (State Vector Report) lists airspeed as “other state vector information”, but does not list heading. Table 3-5 lists airspeed with a note that the data might not be available, and lists “True/Mag heading” only as a modifier of ground track.</p> <p>The attached analysis indicates that the operational benefits of these data are small or nonexistent for basic ADS-B applications. However, some special applications have been identified. Hence it may be useful to accommodate these data but it is important to separate them from the “standard” SV message elements transmitted at high rate by all participating users all the time.</p>				

Originator's proposed resolution:

Remove references to airspeed and heading from paragraph 3.4.3.1 and Table 3-5. Airspeed and heading should be included instead as potential on-condition messages (and associated reports) subject to appropriate conditional events that may be defined by future application developers.

Working Group 6 Deliberations:

April 6, 2001: This Issue Paper was discussed by the ad hoc group at their April 2001 meeting. It was agreed that a new Issue Paper would be written to consolidate all Issue Papers related to Air-reference velocity vectors. When this Issue Paper is approved by the group, this is paper and IP27 will be closed.

May 24, 2001: This Issue Paper was reviewed by the ad hoc group at their May 2001 meeting. It was agreed that this IP will be CLOSED, since IP37 – which will be addressed in Revision A – has been approved which consolidates all material on air-reference velocity vectors from IPs 27, 28, and 242A-WP-4-07.

The four applications that have been identified, for the use of airspeed and heading data, are:

1. Track extension following loss of Earth-referenced positioning information;
2. Meteorological data gathering (combining these data with other data);
3. Enhanced speed control and flow control on approach (a pair-wise application); and
4. Determining aircraft orientation and likely direction of motion when aircraft is stopped.

The operations concept for any future application must contend with existing and projected equipage. Since many GA aircraft will be unable to deliver heading information electronically, the operations concepts for the four applications noted above must contend with a significant number of aircraft which will report other SV data elements but not heading (and possibly not airspeed).

Discussion of Track Extension. Track extension is postulated to provide graceful degradation in the event that all available on-board RNAV sources are rendered inoperable. Even assuming GPS is the only such RNAV source, and only one GPS receiver is installed, the probability of hardware failure is very low and the length of time over which a track can be extended is very short (on the order of 10's of seconds). Hence, very quickly following failure, the data become unusable and there is no point in sending them. So for a long-term outage, these data offer no operational benefit.

Protection against a short-term outage is possible, but most GA aircraft cannot provide heading information so even short-term extension becomes impossible for these aircraft. Any future ATM system must contend with a large number of users who cannot provide heading information – and if the future system can contend with these users, it can apply the same technique to high-end aircraft as well. Furthermore, transport category aircraft (who could easily provide heading information) will likely have multiple GPS receivers installed, using multiple antennas, and the likelihood of even a short-term outage is very low (hence there is no measurable operational benefit).

Since many GA aircraft cannot provide these data, and since the benefits are nonexistent or immeasurably small even for those aircraft that are capable, there does not seem to be any operational benefit of providing airspeed and heading information for track extension.

Discussion of meteorological data gathering. Air-referenced data have value in meteorological data gathering, but the data are not needed at the same update rate as the other SV report elements. Furthermore, only some aircraft are capable of providing the information and when multiple aircraft are in the same airspace, it may be possible to apply sampling in order to minimize the number of reports. Also, at least one existing ADS-B system can provide this application on a side channel avoiding the need to consume ADS-B channel capacity with meteorological data.

Since the update rate for meteorological data gathering is different from that used for other ADS-B applications, and since a ground meteorological application could potentially “sample” the available aircraft to minimize data transfer load, air-referenced data should be separated from the standard SV report elements in the MASPS. Individual ADS-B systems should be allowed the freedom to support this application in an optimum way which may be different for each system.

Turbulence beyond a pre-set threshold, indicated by messages already available on particular data buses, could be used to generate an autonomous “on condition” report of air-referenced data by

those aircraft which can provide the information. The details of the engineering are not important, and each ADS-B technology may have unique methods of accommodation.

Discussion of enhanced speed control and flow control on approach. This is a pairwise application that requires additional cockpit automation and is likely oriented toward transport category and high-end GA aircraft. It does not make engineering sense to *require* the transmission of air-referenced data by all suitably-equipped users *all the time*, merely to have it available during an approach in the event that a suitable pair-wise operation is contemplated.<sup>1</sup> The method of accommodating such special-purpose pair-wise applications should be left to the individual system development teams.

Discussion of heading information for ASMGCS. Heading has been considered for use on the ground, particularly for stopped aircraft as an indication of orientation and future motion (after brake release), but it is not clear that this data element provides any significant operational benefit. Heading does not indicate future intent if the nose wheel is turned or if the pilot *intends* to turn the nose wheel following brake release. The “last velocity vector” (i.e., prior to dropping below some threshold speed) might offer as much utility as heading, or as little, and it is already available with the previously-reported and possibly stored “geometric SV elements”.

Much of the impetus for use of heading information on the ground seems to come from an observed “wander” of display icons associated with stopped aircraft. It is acknowledged that this is an annoying problem. But there are other ways to solve the display problem which do not incur any data link penalty. Since most GA aircraft cannot provide heading information, any solution which relies on this data element will fail to solve the problem for the large majority of aircraft. It would be better to seek a solution that is compatible with all aircraft given current and expected equipage.

If it is determined that heading information is desired for stopped aircraft, the discussion above notwithstanding, then the requirement in MASPS should be keyed to this specific condition. This would allow different design teams to adopt different support concepts keyed to the individual technologies. One design team might choose to send this information all the time; whereas another might choose to send it only when an aircraft is on the surface and not moving.

Summary. There does not appear to be any justification to bundle air-referenced data types with the basic SV transmissions. While these data have value for certain applications, the desired update rates, delivery reliability, and other parameters are different from those associated with the other data types contained in the basic SV transmissions. Hence bundling should be avoided in the MASPS.

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<sup>1</sup> It is possible for a given system to operate with all data transmitted all the time, but this is a design choice rather than an operational requirement, and so it should not be imposed by the MASPS.