TO: Members of RTCA/SC-186/ad hoc committee to revise DO-242

FROM: James Maynard, UPS Aviation Technologies

RE: Selecting which proposed changes are to be considered for DO-242A, the "Rev. A" of the ADS-B MASPS.

In preparation for our second working group meeting, I was asked (Action Item #1-3) to look over comments on the MASPS and recommend which comments should be included in DO-242A and which should be deferred to later revisions of the MASPS.

1. Criteria

In our kick-off meeting, we agreed on the following criteria for selecting which proposed changes to consider for our first revision, DO-242A, of the ADS-B MASPS.

1. MASPS issues that need to be addressed to support near-term MASPS/MOPS development:

    a. DO-260/ED-102 1090 MHz data link MOPS, Rev. A (due 2002-06)

    b. ASA MASPS (due 2001-12)

    c. TIS-B MASPS (due 2001-06)

    d. UAT data link MOPS (due 2001-06)

2. Address applications change items only for applications that have well-defined concepts of operation. "Well defined" means that at least one of the following criteria are met:

    a. The application has a complete application description.

    b. The application has been validated through early operational evaluation experience.

    c. There is a supporting analysis for a candidate "stressing" application.

3. Address items needed for harmonization with international requirements..

4. Address items identified during recent ADS-B development activities and operational evaluations.

5. Address MASPS document clarifications and corrections.

6. Consider validation/modification of questioned MASPS requirements.

7. For a new requirement to be considered, it should be needed to support surveillance for traffic separation assurance.

8. Consider "military use" provision.

In the following table, I will cite these criteria by outline number above. For example, if a proposed change is to be considered for DO-242A because Rev. A of DO-260 requires it, the "suggested resolution" will be annotated as "Include in DO-242A [Criterion 1.a]." If none of these criteria are met, the annotation will be "Defer to DO-242B or later."

2. Tentative Classification of MASPS Change Proposals

2.1. Proposed MASPS Changes Referred by WG-3, the DO-260 1090 MOPS Working Group

#	Comment Author	DO-260 Section		Comment, Rationale	JHM's Suggested Resolution
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1	Livack (2)	1.3.5.2, Incursion Monitoring	11	Make aircraft "make / model" a REQUIRED information set to be transmitted in addition to other parameters already agreed upon. This information is needed to support various airport surface movement applications, noise monitoring, and to support the GA wake vortex modeling application. Intent would be to display an aircraft's silhouette while on the ground and in-flight and / or support a wake vortex alerting algorithm. Display of aircraft silhouette data on a CDTI with alerting is believed to help reduce display clutter. [Reference the various ADS-B surface movement applications. (See RTCA SC – 193, WG-3 airport mapping user requirements document, Appendix section, and Appendix E, DO-242).] **WG#3 Position:** *Items 1-4: Can this information be reliably derived?? Will it cause a bandwidth problems??*	Defer to DO-242B or later.. {There may be other ways to accomplish the goal than specifying aircraft make and model.)
		1.3.6, Other Applications	11		
2	Livack (3)	1.3.5.2, Incursion Monitoring	11	Make aircraft "heading at Vstop" a REQUIRED information set to be transmitted while operating on the airport surface. Otherwise, there appears to be no means to correlate heading when not in motion. [Reference various future surface movement applications.] **WG#3 Position:** *See item 1 above.*	Include in DO-242A [Criterion 4] Experience shows that not having heading at zero ground speed causes CDTI icons to rotate randomly.

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3	Livack (4)	1.3.5.2, Incursion Monitoring 3.3.3, Antenna Location	11 633	Reference the various future surface movement applications. Several of these potential applications will require knowing the exact position (within a few feet) of an aircraft with respect to features on an airport surface. Features in this context include runway hold short markings, penalty box depictions (i.e., "holding" locations), gate areas, etc. So, the issue is how do you establish, then communicate the precise location of an antenna as installed on specific make / model aircraft.	Include in DO-242A. [Criterion 4]. Needed for runway incursion application, which has high priority for early standardization.
4	Livack (5)	1.3.5.2, Incursion Monitoring 4.1.1, General Operation	11 653	Future surface movement application. Aircraft brake "on" or "off" position when operating on the airport surface or, alternatively, aircraft percentage power when operating on the airport surface. It is believed that either or both parameters, when integrated into the ADS-B position report, will give significant advance notification / alerting of a pending aircraft movement and thus could be used to provide alerts to a potential runway incursion. **WG#3 Position:** *See item 1 above.*	Consider for DO-242A. [Criterion 4]. May be needed for runway incursion application, which has high priority for early standardization.
5	Livack (7)	1.3.6, Other Applications 2.2.5.1.11, Aircraft ID Data	11 124	General aviation issue. The function / process to achieve GA ADS-B anonymity protection when using the 1090 data link appears not to have been addressed. For example, in the UAT implementation in Alaska, by modifying the ICAO 24 bit code, the UAT implementation effectively moots the ability to use the assigned 24 bit ICAO registry data in conjunction with a look-up table to identify aircraft by Make / Model. A similar 1090 MOPS anonymity function needs to be specifically included in this current version of the MOPS. However, any CDTI or controller's display must maintain its ability to display aircraft make / model silhouettes but without the ID data tag. **WG#3 Position:** *Need a uniform statement on the need for this in the MASPS, but if randomness is needed to get full anonymity, WG#3 has a great concern that randomness will cause duplicate addresses to appear within proximity of each other which violates the MASPS. WG#3 does not feel non-unique addresses are good, but if this is the unified RTCA position for broadcast-only devices, WG#3 can technically make it work.*	Consider for DO-242A. [Criteria 1.a, 1.d]. Two of the data links, VDL M4 and UAT, already support "anonymous" addresses for GA aircraft not requiring ATC services, and such support seems likely to be added to the 1090 MOPS, DO-260A, as well.

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6	Livack (10)	1.3.6 Table 2-9A Table 2-72	11 37 171	Safety issue. Fixed and tethered obstacles, while addressed in general terms in the draft 1090 MOPS, are not addressed well. Additionally, there appears to be no apparent means specified to mark (and thus depict) moving vehicles that create obstructions. Moving obstructions include, for example, vehicles operating on or off hard surface roads on airports, trains operating on railroad tracks immediately adjacent to runway thresholds, and vessels operating on navigable waterways, all of which can create a hazard or obstruction especially on or near airports.	Reject. (Agree with WG-3's position.)
7	Livack (11)	1.3.6 Table 2-9A Table 2-72	11 37 171	Safety issue. Catenary and other continuous obstacle depictions are not addressed. There are many other types of obstacles that do not fit well as a point-obstacle depiction, such as tall tree-lines, building clusters, dams, and microwave transmission corridors. These types of obstacles require a more complex message description. Towers supporting catenaries should be depicted and a special representation used for catenaries because the catenary itself may be a significant obstruction. In these cases, catenaries need to be depicted as a linear feature with the adjacent support towers depicted at either end. **WG#3 Position:** Candidate for Nav database rather than an ADS-B system.	Reject. (Agree with WG-3's position.)
8	Livack (14)	1.3.6	11	Non airport surface movement potential (future) application. There appears to be a lack of specificity as to whether (and specifically how) the 1090 data link can support the future air-to-air and / or air-to-ground exchange of FIS-B downlink enabled AUTOMETS for MET reporting. This application is of high interest, with funding for low-cost GA sensors being provided by NASA's AWIN program although, as of this time, their concept is data link independent. (The ADS-B AUTOMET concept uses ADS-B as the means to exchange aircraft ID and position reporting and MET data, thereby saving overall bandwidth and equipage costs, especially for the GA owner). Several ADS-B MET-related messages set elements will need to be exchanged. These data sets are defined in some detail in DO-252. The AUTOMET application is also described in DO-252. See also Appendix E of DO-242. **WG#3 Position:** Items #8 and 9 WG#3 doubts the maturity of these future applications is such to warrant consideration into DO-242A.	Reject. (DO-242A is an ADS-B MASPS, not a FIS-B MASPS.) [WG-3 might, however, wish to consider this if the 1090 MHz data link MOPS is revised to support FIS-B in addition to ADS-B.]

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9	Livack (15)	1.3.6	11	Another potential (future) application, but as yet not validated. There appears to be a lack of specificity as to how the 1090 data link can be used to support the air-to-air (and air-to-ground) exchange of a LIMITED sub-set of the above FIS-B AUTOMET parameters for use in ADS-B wake vortex modeling. In this application, ADS-B would be used to exchange aircraft ID, aircraft position information, and certain wake vortex modeling parameters. It is believed that this wake vortex modeling concept could help enhance Safe Flight 21 Application # 3.2 approach spacing and SF 21 Application # 3.4, departure spacing / clearance tool, by allowing for safe (but reduced) in-trail separation on arrival and departure. Several data set elements have been identified but not yet flight validated as part of an integrated ADS-B wake vortex modeling application. A graduate student at Stanford University is presently conducting research on this subject, and can be contacted through Gary Livack, FAA. Flight evaluations are planned for this Summer. **WG#3 Position:** *Items #8 and 9 WG#3 doubts the maturity of these future applications is such to warrant consideration into DO-242A.*	Defer to DO-242B or later. (I agree with WG-3's position.)
10	Maynard (22)	2.2.3.2.3.1.2	42	Selecting the type code based on accuracy information (HFOM) in the absence of integrity information (HPL) is bogus. The type code carries integrity information (NUC_P, which should later be renamed NIC for Navigation Integrity Level). HPL is an integrity bound, but HFOM is only an accuracy bound. **WG#3 Position:** Items #10, 11, and 12: Will accommodate these items if NIC/NAC is incorporated into DO-242A. However, WG#3 has seen great difficulty in getting this information (especially NUCR), and cautions that to now require this data in a more specific manner will not be easy. WG#3 would like to see writeups on exactly how this information is to be derived.	Include in DO-242A [Criterion 1.b]. WG-4 appears to be likely to require this in the ASA MASPS.
11	Maynard (34)	2.2.3.2.4.1.2	57	Same comment as James Maynard (22) above, but for the type code in the Surface Position Message. **WG#3 Position:** *See item 10 above.*	Include in DO-242A [Criterion 1.b]. WG-4 appears to be likely to require this in the ASA MASPS.
12	Maynard (37)	2.2.3.2.4.1.4.c	57	Same comment as James Maynard (22) above, but for the Surface Position Message. **WG#3 Position:** ***See item 19 above.***	Include in DO-242A [Criterion 1.b]. WG-4 appears to be likely to require this in the ASA MASPS.

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13	Moody (4)	2.2.3.2.6.1.2	71	Subtypes 1 and 2 use N/S E/W (velocity over ground) and Subtypes 3 and 4 use Magnetic Heading and Airspeed. The subtypes that include magnetic heading and airspeed are to be used only when velocity over the ground is "not available" according to Table 2-17. Is the "not available" meant in a *failure* or *installation doesn't support* context? If it is for failure of velocity over ground, wouldn't that likely include failure of position as well? And if that's the case, is subtype 3 and 4 really worth the trouble given it is reported mutually exclusive with velocity over ground? If it is worth it, is it required that every installation support a magnetic heading and ground speed input? **WG#3 Position:** *It is possible to have a simpler navigator which would use subtypes 3 & 4 due to "not available" conditions and not just "failure" conditions. This would mean that subtypes 3 & 4 are required by 1090 MHz ADS-B to stay in compliance with DO-242A.* *Also, WG#3 feels the MASPS should be revised so that it is NOT required to provided both ground and air referenced data at the same time.*	Consider for DO-242A. [Criterion 6.]
14	Moody (7)	2.2.3.2.7.1.3	91	*Are all these various trajectory types required by the MASPS? Doesn't the MASPS assume a straight geodesic course to all TCPs?* **WG#3 Position:** *Non-issue. WG-3 admittedly went beyond MASPS requirements.*	Do not include DO-260 trajectory types in DO-242A. (Consider TCP types in connection with WG-4's proposals, instead.)
15	Hilb (5)	2.2.3.2.7.1.4	92	The use of TCP Data Valid Subfield is not well explained. **Temporary resolution:** Changed 2.2.3.2.7.1.4 to show zero (0) as the only acceptable coding value for initial 1090 MOPS publication. Changed 2.4.3.2.7.1.4, Step 1 to test for condition zero (0) only. **WG#3 Position:** *WG#3 agrees this issue needs addressed in DO-242A.*	Consider for DO-242A. [Criteria 1.a, 1.b]
16	Hilb (2)	2.2.3.2.7.2	94	TCAS RA status is needed for CD&R application **WG#3 Position:** *Before finalizing position, WG#3 will discuss further with Bob Hilb as to why he wants coordination data rather than just own A/C's RA data. (Easier for transponder to access??)*	Include in DO-242A. [Criterion 1.a]

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17	Hilb (6)	2.2.3.2.7.3.3.1	98	Table 2-54 – Many of the initial applications depend on the controller and other flight crew knowing if an A/C has an operational CDTI. The CD&R application needs to know if the other A/C has an operational TCAS. **Temporary resolution:** Changed Table 2-54, initially as suggested by Hilb, but further discussion by Jerry Anderson, Vince Orlando and others during the CPR correction phase after Plenary led to a revision of the meanings as published in the initial 1090 MOPS. **WG#3 Position:** *WG#3 agrees this issue needs addressed in DO-242A. Also, WG#3 has revised the table that is in the published MOPS. To read as follows:* **Resolution (by SC-186):** In DO-260's Aircraft Operational Status Message, the "CC_4" subfield in which bits 9-10 = 00 was assigned values for bits 10-11 to accommodate this request. Bit 9, 10, 11, 12 Meaning 0000 TCAS Not Operational, CDTI Not Operational or unknown 0001 TCAS Not Operational, CDTI Operational 0010 TCAS Operational, CDTI Not Operational or unknown 0011 TCAS Operational, CDTI Operational	Include in DO-242A. [Criterion 1.a]
18	Cassell (1)	2.2.3.3.2.3	106	Changing the broadcast rate from a nominal 0.5 seconds to 5.0 seconds when the target is stopped will cause a 5 second delay in alerting on runway incursions. This occurs when an aircraft crosses a hold line from a stop. This is unacceptable from a safety standpoint. Temporary resolution: Added a new Note after 2.2.3.3.2.3.c indicating that further analysis is necessary and it was believed that the rate would be raised to once per second. **WG#3 Position:** WG#3 feels that changing the 10 ft criteria for detecting movement to 3 ft would be a better solution than changing the low-rate from 5 seconds to 1 second. With most airports that would have a runway incursion system also having LAAS the 3 ft precision should be attainable. This would prevent us from having to change DO-181 also and therefore be a cleaner solution. If this solution is acceptable, there is not an issue here for DO-242A.	Address in DO-242A. [Criteria 1.a, 1.b] Needed for the runway incursion application, which is a high priority for the near term.
19, 20	Cassel (2, 3)	2.2.5.1.7, 2.2.5.1.8	121, 122, J-58	The ADS-B MASPS indicated that for surface movement requirements, that the [own position latitude] reports are assumed to be given with respect to a "certified navigation center" of the aircraft (DO-242, Section J.3.2.2). This is necessary to ensure meeting the overall accuracy requirements for surface surveillance. The 1090 MOPS fails to specify anything about the reference point for the position information. Temporary resolution: Added a new Note after 2.2.5.1.7.c indicating that any application that uses ADS-B surface position information will have to take into account the offset of the information to the navigation reference point. WG#3 Position: Items #19 & 20: WG#3 feels this information would be extremely difficult to include from an installation/airframe standpoint. WG#3 feels that the current buffer for transmitting of antenna is adequate.	Address in DO-242A. [Criteria 1.a, 1.b] Needed for the runway incursion application, which is a high priority for the near term. [I suggest that we might address this as a data element, distance of navigation center (e.g., GPS antenna) from nose of aircraft, that is required to be transmitted by those aircraft that announce that they support the runway incursion application.]

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21	Moody (5))	2.2.5.1.19	128	This paragraph describes the encoding of the Velocity Subtype. The implication is that the subtype information is handed to the ADS-B system from an external input. Instead should not the ADS-B installation have to determine the subtype appropriate for a given condition? **Temporary resolution:** This section was initially entitled "Subtype (Velocity) Data" and dealt with the 'transmitting device accepting own vehicle Subtype information via an appropriate variable data input interface.' This section was deleted as a result of discussions and the section relabeled "Unused." WG#3 POSITION: ***ITEMS 21 & 22: NO LONGER ISSUS SINCE RELATED TEXT WAS DELETED.***	Not an issue.
22	Moody (6)	2.4.3.2.6.1.2	343	This paragraph describes verification of subtype field in the velocity message. Step 3 of this procedure implies that all one need to do to get a subtype 3 to happen is to "provide velocity information in the form of airspeed and heading…". But from Table 2-17 it would seem it would also require the UNavailability of velocity over ground **WG#3 Position:** *Items 21 & 22: No longer issus since related text was deleted.*	Not an issue.
23	Moody (16)	3.1	629	Should any Class of equipment be allowed to use a VFR GPS system? Every ADS-B installation will likely support conflict avoidance and some ground based ATC services. We really don't make a VFR/IFR distinction for transponders; should we for the data source requirements for A0/A1/B1? **Moody's Recommendatation:** Have consistent minimum information source requirements for A0/A1/B1. **WG#3 Position:** *WG#3 agrees this issue needs addressed in DO-242A.*	Address in DO-242A. [Criterion 5.]
24	Livack (18)	Appendix D		Architecture question. Might the 1090 ADS-B MOPS implementation be able to broadcast a carrier-only message set when there was a loss in nav function? Might multiple TIS-B ground sites be able to process this information, then uplink "own ship" track files, so as to provide some level of back-up secondary navigation capability? Some say that RNP 1 is possible with this very "crude" back-up navigation system. If technically feasible, this functionality needs to be specifically included in the draft 1090 MOPS. **WG#3 Position:** ***WG#3 does not find these items to be at a high enough maturity level to be incorporated into DO-260A.***	Omit. Outside scope of ADS-B MASPS, although it may be within scope of a data link MOPS.

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25	Livack (17)	Appendix F, R2.29		Add souls on board (SOB) and fuel on board (FOB) and broadcast this information in the event of an emergency. This data is needed for enhanced CFR response. **WG#3 Position:** *WG#3 does not see how this data items could feasably be included and updated in an accurate manner.*	Defer to later MASPS version. [Criterion 2.] We do not have a well-developed concept of operation for an early ADS-B application that requires this information.

2.2. Proposed MASPS Changes Listed in MASPS Issue Papers

#	Comment Author	MASPS Reference	Issue Description	JHM's Suggested Resolution
IP-01	Heppe	§2.1.2.2.3	Turn indication is described as turning left, turning right or not turning. Table 2-2 indicates that it is a required message element for roughly half of the indicated applications. However, GPS cannot determine when an aircraft is turning (it cannot differentiate between a turn and a lateral wind gust). Even an FMS may be unable to differentiate between a turn and a lateral wind gust, sideslip, etc. unless the aircraft is operating under full autopilot. If the aircraft is being flown manually, the pilot will be making continual control inputs which could be easily mistaken for the start of a turn (leading to potential false alarms by receiving aircraft). If the aircraft is on full autopilot, TCPs are much more effective and operationally useful.	Consider for DO-242A. [Criterion 5.] The source of information for turn indication, and the thresholds for determining whether or not an aircraft is turning, are problematic. [In the absence of guidance from other committees as to what those thresholds should be, WG-3 resorted to specifying in the DO-260 1090 MHz ADS-B MOPS that the turn indicator should be set to zero, indicating that turn indicator information was not available.]
IP-02	Heppe	§2.1.2.2.2.2, Table 2-2	Altitude rate is described as climbing or descending with rates reported up to 32,000 fpm. The MASPS variously requires barometric or inertially augmented barometric, or geometric, altitude rate depending on NUC category. Table 2-2 indicates that it is a required message element for all applications listed. The rationale for altitude rate was originally based on simulations which attempted to demonstrate improved warning time for "incursions" during vertical maneuvers (see DO-242 Appendix J section J.3.1.1.2). The simulations seem to indicate that reporting altitude rate can marginally improve warning time when an aircraft is climbing through, or leveling-off at, own ship's altitude (note: detailed simulation results are not contained in DO-242). However, the operations concept to generate this information on the transmit side, and use it on the receiving side, has never been described. Furthermore the existing simulations do not account for updrafts and downdrafts which can significantly affect instantaneous vertical rate (especially in extreme weather conditions). Variations in vertical rate on the order of ±1000 fpm occur with relatively high probability. Since the vertical rate experienced by an aircraft is subject to large-amplitude short-term fluctuations, some form of averaging or smoothing will likely be required in order to avoid false alarms. Any form of averaging would require standardization and extensive analysis to ensure it was appropriate for all aircraft types. But if the averaging time stretches to even a few seconds, it would be more appropriate (and consume fewer bits) to simply take the difference between the altitudes reported in the last two messages.	Consider for DO-242A. [Criterion 5.]
IP-03	Heppe	§3.3.3.1, Table 3-4	Table 3-4 indicates a need for 95% probability of update within 3 seconds at 3 nmi, for Aid to Visual Acquisition (the 99% value is at 6 seconds). A footnote indicates it is really the 99% value that drives the requirement, but either way the update rate is very rapid. For a number of reasons this does not appear to make any operational sense. See the discussion attached.	Consider for DO-242A. [Criterion 5.]
IP-04	Livack		See §2.1 above, items #1, #2, #3, and #4	See §2.1 above, items #1, #2, #3, and #4
IP-05	Livack		See §2.1 above, item #5.	See §2.1 above, item #5.
IP-06	Livack		See §2.1 above, items #6 and #7	See §2.1 above, items #6 and #7
IP-07	Livack		See §2.1 above, items #8. #9, #24, and #25.	See §2.1 above, items #8. #9, #24, and #25.
IP-08	Maynard		See §2.1 above, items #10, #11, and #12.	See §2.1 above, items #10, #11, and #12.
IP-09	Moody		See §2.1 above, item #13.	See §2.1 above, item #13.
IP-10	Moody		See §2.1 above, item #23/	See §2.1 above, item #23/
IP-11	Hilb		See §2.1 above, item #15.	See §2.1 above, item #15.
IP-12	Hilb		See §2.1 above, items #16 and #17	See §2.1 above, items #16 and #17
IP-13	Cassell		See §2.1 above, item #18.	See §2.1 above, item #18.
IP-14	Cassell		See §2.1 above, items #19 and #20	See §2.1 above, items #19 and #20