

RTCA Special Committee 186, Working Group 3
EUROCAE WG-51, SG-1

ADS-B 1090ES MOPS Maintenance

Meeting #25

Eurocontrol Headquarters, Brussels Belgium
17 – 20 February 2009

Report on Action Item 24-19 Regarding
Change Item #28 - Validation ground/switch
Revision 1

Eric Potier
Eurocontrol

Summary
This Working Paper addresses action item 24-19 related to Change item #28 about the consistency of the validation of the on-the-ground status between 1090MOPS and the Mode S transponder MOPS.

1 Introduction

This Working Paper addresses action item 24-19 related to Change item #28 about the consistency of the validation of the on-the-ground status between 1090MOPS and the Mode S transponder MOPS.

2 Comparison of 1090 MOPS with Mode S transponder Mops

1090 MOPS++	Mode S transponder MOPS DO181-D																																																														
<p>2.2.3.2.1.2 “CA” Capability Field (used in DF=17)</p> <p>a. Definition:...</p> <p>b. Transponder Use...</p> <p>c. Air/Ground Determination: ...</p> <p>d. Validation of Ground Status:</p> <p><i>Note: For aircraft with an automatic means of determining vertical status (i.e., weighton-wheels, strut switch, etc.) the “CA” field reports whether the aircraft is airborne or on the ground. TCAS acquires aircraft using the acquisition squitters or extended squitters, both of which contain the “CA” field. If an aircraft reports that it is on the ground, that aircraft will not be interrogated by TCAS in order to reduce unnecessary interrogation activity. The 1090 MHz ADS-B Message formatter may have information available to validate that an aircraft reporting “on-the-ground” is actually on the surface.</i></p> <p>If the automatically determined Air/Ground status is not available or indicates that the Airborne Position Message (see §2.2.3.2.3) shall be broadcast, then the Airborne Position Message shall be broadcast in accordance with subparagraph c.</p> <p>If one of the conditions in Table 2-10 is satisfied, then the Air/Ground status shall be changed to “Airborne” and the Airborne Position Message (see §2.2.3.2.3) shall be broadcast irrespective of the automatically determined Air/Ground status.</p> <p>Table 2-10: Validation of “ON-GROUND” Status</p>	<p>c. Validation of declared on-the-ground status</p> <p>Note 2: For aircraft with an automatic means of determining vertical status, the CA field reports whether the aircraft is airborne or on the ground. ACAS II acquires aircraft using the short or Extended Squitter, both of which contain the CA field. If an aircraft reports on-the-ground status, that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity.</p> <p>For Aircraft with an automatic means for determining the on-the-ground condition, transponders that have access to at least one of the following parameters (ground speed, radio altitude, airspeed) shall perform the following validation check:</p> <p>If the automatically determined air/ground status is not available or is “airborne”, no validation shall be performed.</p> <p>If the automatically determined air/ground status is available and the “on-the-ground” condition is being reported, the air/ground condition shall be overridden and changed to “airborne” if:</p> <p>Ground Speed > 100 knots OR Airspeed >100 knots OR Radio Altitude > 50 feet.</p>																																																														
<table border="1"> <thead> <tr> <th colspan="6">Airborne Position Message Broadcast</th> </tr> <tr> <th colspan="2">ADS-B Emitter Category Set “A”</th> <th rowspan="2">Ground Speed</th> <th rowspan="2"></th> <th rowspan="2">Airspeed</th> <th rowspan="2">Radio Altitude</th> </tr> <tr> <th>Coding</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No ADS-B Emitter Category Information</td> <td colspan="4">No Change to “On-the-Ground” status</td> </tr> <tr> <td>1</td> <td>Light (<15,500 lbs.)</td> <td colspan="4">No Change to “On-the-Ground” status</td> </tr> <tr> <td>2</td> <td>Small (15,500 to 75,000 lbs.)</td> <td>> 100 knots</td> <td>or</td> <td>> 100 knots</td> <td>> 50 feet</td> </tr> <tr> <td>3</td> <td>Large (75,000 to 300,000 lbs.)</td> <td>> 100 knots</td> <td>or</td> <td>> 100 knots</td> <td>> 50 feet</td> </tr> <tr> <td>4</td> <td>High-Vortex Large (aircraft such as B-757)</td> <td>> 100 knots</td> <td>or</td> <td>> 100 knots</td> <td>> 50 feet</td> </tr> <tr> <td>5</td> <td>Heavy (> 300,000 lbs.)</td> <td>> 100 knots</td> <td>or</td> <td>> 100 knots</td> <td>> 50 feet</td> </tr> <tr> <td>6</td> <td>High Performance (> 5g acceleration and >400 knots)</td> <td>> 100 knots</td> <td>or</td> <td>> 100 knots</td> <td>> 50 feet</td> </tr> <tr> <td>7</td> <td>Rotorcraft</td> <td colspan="4">No Change to “On-the-Ground” status</td> </tr> </tbody> </table>	Airborne Position Message Broadcast						ADS-B Emitter Category Set “A”		Ground Speed		Airspeed	Radio Altitude	Coding	Meaning	0	No ADS-B Emitter Category Information	No Change to “On-the-Ground” status				1	Light (<15,500 lbs.)	No Change to “On-the-Ground” status				2	Small (15,500 to 75,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet	3	Large (75,000 to 300,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet	4	High-Vortex Large (aircraft such as B-757)	> 100 knots	or	> 100 knots	> 50 feet	5	Heavy (> 300,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet	6	High Performance (> 5g acceleration and >400 knots)	> 100 knots	or	> 100 knots	> 50 feet	7	Rotorcraft	No Change to “On-the-Ground” status				<p>Note 3: For Extended Squitters installation, the on-the-ground validation is optional for Aircraft reporting ADS-B Emitter Category Set “A” codes 0, 1 or 7 as defined in the latest version of RTCA/DO-260A, 2.2.3.2.1.2..</p> <p>Note 4: Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the air/ground state based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the air/ground state and do not require additional validation.</p>
Airborne Position Message Broadcast																																																															
ADS-B Emitter Category Set “A”		Ground Speed		Airspeed	Radio Altitude																																																										
Coding	Meaning																																																														
0	No ADS-B Emitter Category Information	No Change to “On-the-Ground” status																																																													
1	Light (<15,500 lbs.)	No Change to “On-the-Ground” status																																																													
2	Small (15,500 to 75,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet																																																										
3	Large (75,000 to 300,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet																																																										
4	High-Vortex Large (aircraft such as B-757)	> 100 knots	or	> 100 knots	> 50 feet																																																										
5	Heavy (> 300,000 lbs.)	> 100 knots	or	> 100 knots	> 50 feet																																																										
6	High Performance (> 5g acceleration and >400 knots)	> 100 knots	or	> 100 knots	> 50 feet																																																										
7	Rotorcraft	No Change to “On-the-Ground” status																																																													
<p>Note: Aircraft reporting ADS-B Emitter Category Set “A” codes 0, 1 or 7 with an automatic means to determine the on-the-ground status, and means to validate that status, may change the status to “Airborne” if the on-the-ground status cannot be validated.</p>																																																															

3 Discussion & Proposal

Forcing ground format:

Section 2.2.3.2.1.2 bullet c) has already been changed i.e., what to do to force the surface position format when the aircraft is on the ground.

Forcing airborne state and format when the system is wrongly reporting on the ground:

The validation of the on-the-ground status consists in forcing the airborne state when there is a doubt on the “ground “ state as airborne state is the safest position.

DO260 still uses a table to define different validations of the on-the-ground status depending on the emitter category while transponder MOPS and new ICAO SARPS have been simplify to a simple formula not depending on the emitter category.

In the present MOPS there is no validation of the on-the-ground status when:

- there is no information on the Emitter category (0),
- it is a light aircraft (<15,500 lbs.) (1)
- it is a rotorcraft (7)

Issue:

During the review of transponder MOPS and ICAO Annex 10 it has been considered as the safest option to extend the validation of the on-the-ground status (forcing airborne status when there is a doubt) to the all possible platforms having access to the necessary information.

In 1090 MOPS the validation of on-the ground status is still limited and not used when there is no emitter category, when it is a light aircraft or when it is a rotorcraft?

Proposal:

The simplest and safest option is to simplify the requirement and make the validation valid for all emitter categories as specified in the transponder MOPS and new ICAO SARPS.

In the worst case the criteria will possibly not be met (e.g. Speed less than 100 knots) and there will be no change to the on-the ground status and type of ES transmitted.

Proposed new text for 1090 MOPS:

“2.2.3.2.1.2 “CA” Capability Field (used in DF=17)

...

d. Validation of Ground Status:

Note: For aircraft with an automatic means of determining vertical status (i.e., weight on wheels, strut switch, etc.) the “CA” field reports whether the aircraft is airborne or on the ground. TCAS acquires aircraft using the acquisition squitters or extended squitters, both of which contain the “CA” field. If an aircraft reports that it is on the ground, that aircraft will not be interrogated by TCAS in order to reduce unnecessary interrogation activity. The 1090 MHz ADS-B Message formatter may have information available to validate that an aircraft reporting “on the ground” is actually on the surface.

If the automatically determined Air/Ground status is not available or indicates that the Airborne Position Message (see §2.2.3.2.3) shall be broadcast, then the Airborne Position Message shall be broadcast in accordance with subparagraph e.

If Ground Speed > 100 knots OR Airspeed > 100 knots OR Radio Altitude > 50 feet, then the Air/Ground status shall be changed to “Airborne” and the Airborne Position Message (see §2.2.3.2.3) shall be broadcast irrespective of the automatically determined Air/Ground status.

d. Validation of Ground Status:

Note: For aircraft with an automatic means of determining vertical status (i.e., weight-on-wheels, strut switch, etc.) the “CA” field reports whether the aircraft is airborne or on the ground. TCAS acquires aircraft using the acquisition squitters or extended squitters, both of which contain the “CA” field. If an aircraft reports that it is on the ground, that aircraft will not be interrogated by TCAS in order to reduce unnecessary interrogation activity. The 1090 MHz ADS-B Message formatter may have information available to validate that an aircraft reporting “on-the-ground” is actually on the surface.

If the automatically determined Air/Ground status is not available or indicates that the Airborne Position Message (see §2.2.3.2.3) shall be broadcast, then the Airborne Position Message shall be broadcast in accordance with subparagraph c.

If Ground Speed > 100 knots OR Airspeed > 100 knots OR Radio Altitude > 50 feet, one of the conditions in Table 2-10 is satisfied, then the Air/Ground status shall be changed to “Airborne” and the Airborne Position Message (see §2.2.3.2.3) shall be broadcast irrespective of the automatically determined Air/Ground status.

Airborne Position Message Broadcast						
ADS-B Emitter Category Set “A”		Ground Speed		Airspeed		Radio Altitude
Coding	Meaning					
0	No ADS-B Emitter Category Information	No Change to “On-the-Ground” status				
1	Light (<15,500 lbs.)	No Change to “On-the-Ground” status				
2	Small (15,500 to 75,000 lbs.)	> 100 knots	or	> 100 knots	or	> 50 feet
3	Large (75,000 to 300,000 lbs.)	> 100 knots	or	> 100 knots	or	> 50 feet
4	High-Vortex Large (aircraft such as B-757)	> 100 knots	or	> 100 knots	or	> 50 feet
5	Heavy (> 300,000 lbs.)	> 100 knots	or	> 100 knots	or	> 50 feet
6	High Performance (> 5g acceleration and >400 knots)	> 100 knots	or	> 100 knots	or	> 50 feet
7	Rotorcraft	No Change to “On-the-Ground” status				

Table 2-10: Validation of “ON-GROUND” Status

Note: Aircraft reporting ADS-B Emitter Category Set “A” codes 0, 1 or 7 with an automatic means to determine the on-the-ground status, and means to validate that status, may change the status to “Airborne” if the on-the-ground status cannot be validated.

Note: Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the air/ground state based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the air/ground state and do not require additional validation.