# RTCA Special Committee 186, Working Group 5

# ADS-B UAT MOPS

# Meeting #11

# ADS-B Data Link Analysis: UAT in the 2015 Core Europe Scenario

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| SUMMARY |
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| **This paper represents a summary of the simulation runs for UAT in the 2015 Core Europe Scenario, and a summary the comparison of results between Helios and the Eurocontrol Experimental Centre.** |

# ADS-B data link analysis:
# UAT in the 2015 Core Europe Scenario

## Introduction

This note presents the results of simulations of the performance of the UAT in the 2015 core Europe scenario.

The analysis uses the following inputs:

- The 2015 core Europe scenario, in which there are 2091 aircraft within a 300 NM range. This represents almost a doubling of present traffic levels.
- The observer aircraft is at 30 000 ft in the centre of the scenario.

## Approach and baseline results

The tools used in the simulations were:

- A model of UAT performance, developed by the John Hopkins University in the US.
- A monte carlo simulation to analyse the model output and determine the effective update period (EUP) of the UAT. This indicates the ability to meet ADS-B applications defined in the ADS-B MASPS.

The main assumptions used in the model are:

- Simulation time: 300 sec
- Filter bandwidth: 0.8 MHz
- Aircraft altitude: 30000 ft
- Receiver configuration: diversity (switched and double receiver)
- A0 transmit power range: 38.5 to 42.5
- A1 transmit power range: 42 to 46
- A2 transmit power range: 42 to 46
- A3 transmit power range: 50 to 54
- Number of DMEs: 1 (power = -79.00 dBm)
- Number of TACANs: 2 (powers = -64.00 dBm and -67.00 dBm)
- JTIDS: none

Results from the model, shown in Figure 1, show the 95% effective update period (EUP) for A3 aircraft types. The MASPS 95% SV EUP update requirements are also shown. It is apparent that the A3 aircraft exceeds the MASPS requirements for 95% EUP update at all ranges.

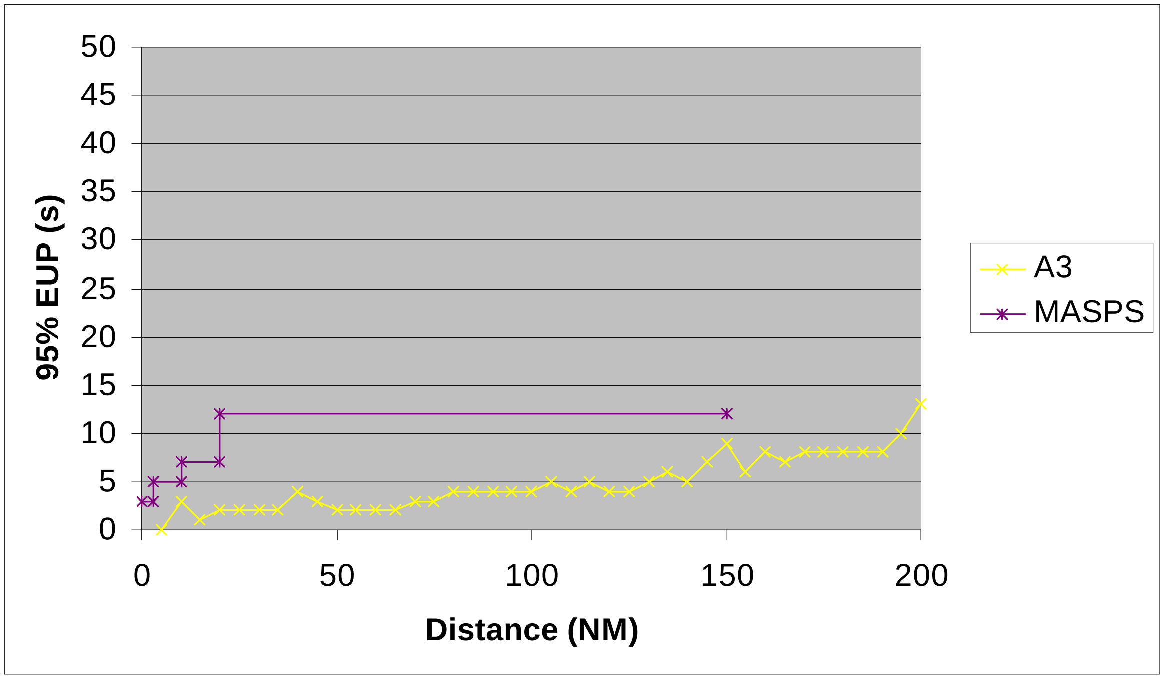


**Figure 1: 95% EUP for A3 aircraft**

Table 1 shows the A3 aircraft performance against MASPS ADS-B applications tests.

| **Application** | **Maximum update range** | **Performance against test criteria** |
|---|---|---|
| Simultaneous approach | 2500 ft | Pass |
| Aid to visual acquisition | 10 NM | Pass |
| Conflict and collision avoidance | 20 NM | Pass |
| Separation assurance and sequencing | 40 NM | Pass |
| Flight path deconfliction and planning | 90 NM | Pass |

**Table 1: A3 aircraft MASPS ADS-B application test results**

### Analysis by aircraft type

The output of the decoder was analysed by aircraft type and the results shown in Figure 2. Note that the results for A0, A1 and A2 aircraft are based on an A3 receiver configuration, and hence are optimistic since the A3 receiver configuration is better than the others.

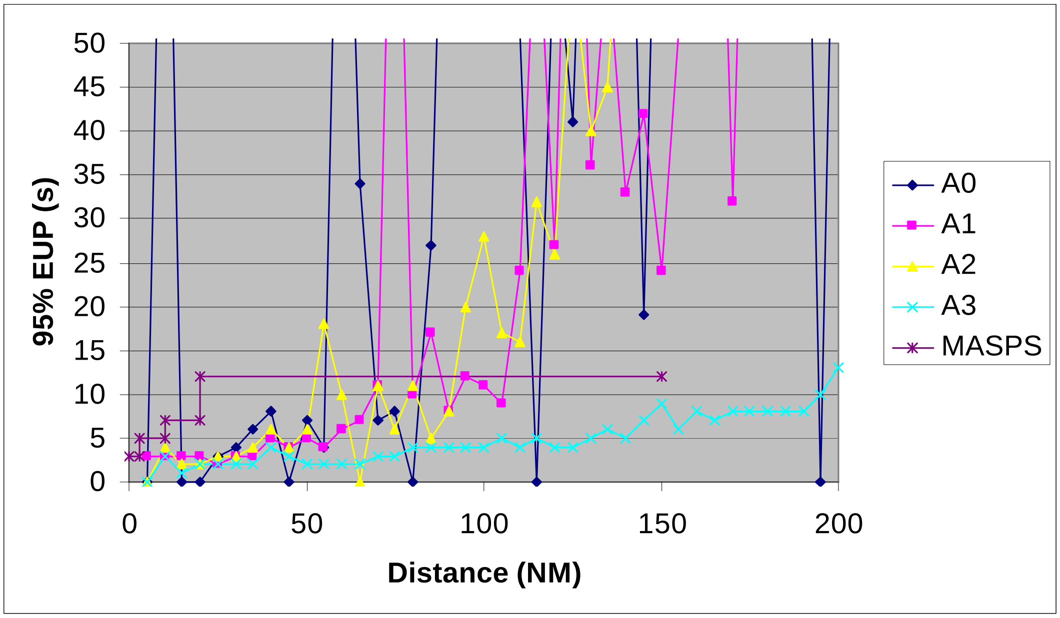


**Figure 2: 95% EUP for all aircraft types**

Table 2 shows the results of the MASPS ADS-B application tests for each aircraft type. The trend is as expected, ie that higher-capability aircraft meet more of the requirements. Again it should be noted that the A0, A1 and A2 results are optimistic because the simulations used an A3 receiver configuration.

Cells shown in grey are applications that are *not* required by that aircraft type.

| **Application** | **Maximum update range** | **Performance against test criteria for different aircraft types** | | | |
|---|---|---|---|---|---|
| | | **AO** | **A1** | **A2** | **A3** |
| Simultaneous approach | 2500 ft | Pass | Pass | Pass | Pass |
| Aid to visual acquisition | 10 NM | Fail | Pass | Pass | Pass |
| Conflict and collision avoidance | 20 NM | Fail | Pass | Pass | Pass |
| Separation assurance and sequencing | 40 NM | Pass | Pass | Pass | Pass |
| Flight path deconfliction and planning | 90 NM | Fail | Fail | Fail | Pass |

**Table 2: MASPS ADS-B application test results by aircraft type**

## Comparison with EEC results

The analysis technique was compared against that of the Eurocontrol Experimental Centre (EEC). A comparison of both results for A3 aircraft is shown in Figure 3. Both techniques show a similar trend and give the same conclusions regarding MASPS performance.

At long ranges the EEC results are worse than the Helios results. The differences are mostly caused by differences in the analysis approaches and differences in the number of simulation runs used by Helios and the EEC. (Both techniques are statistical, so some variation is inevitable.)

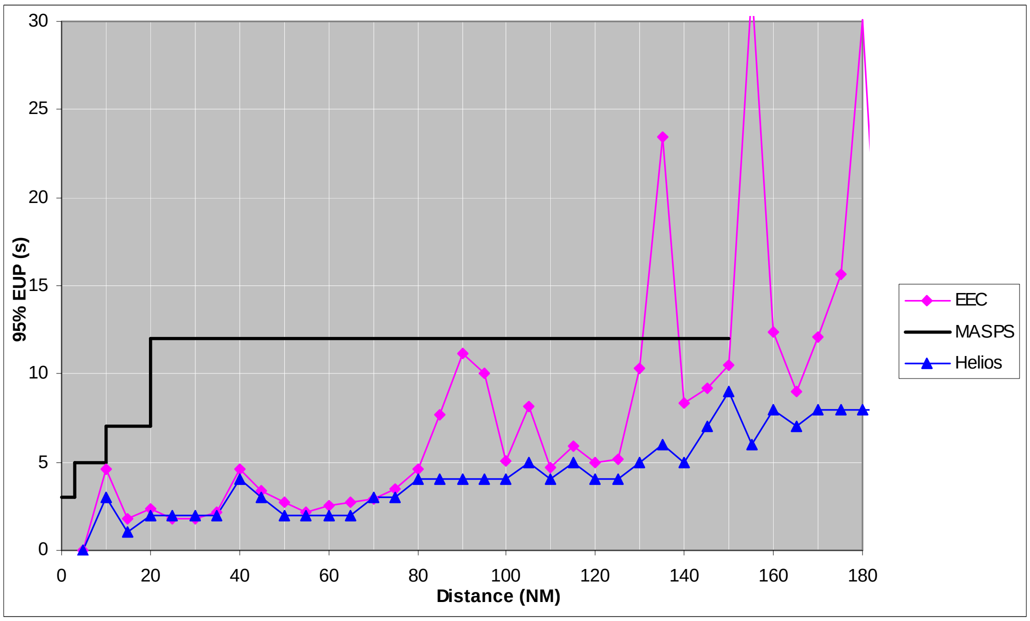


**Figure 3: Comparison with EEC results for A3 aircraft**

## Using a switched receiver instead of a dual receiver

The effect of using a switched receiver in the UAT aircraft instead of a dual receiver was tested in the simulation. The resulting 95% EUP for A3 aircraft is shown in Figure 4. The results are close.

In some cases the switched receiver performs slightly better than the dual receiver, which is unexpected. This is thought to be due to the statistical variations in the results.

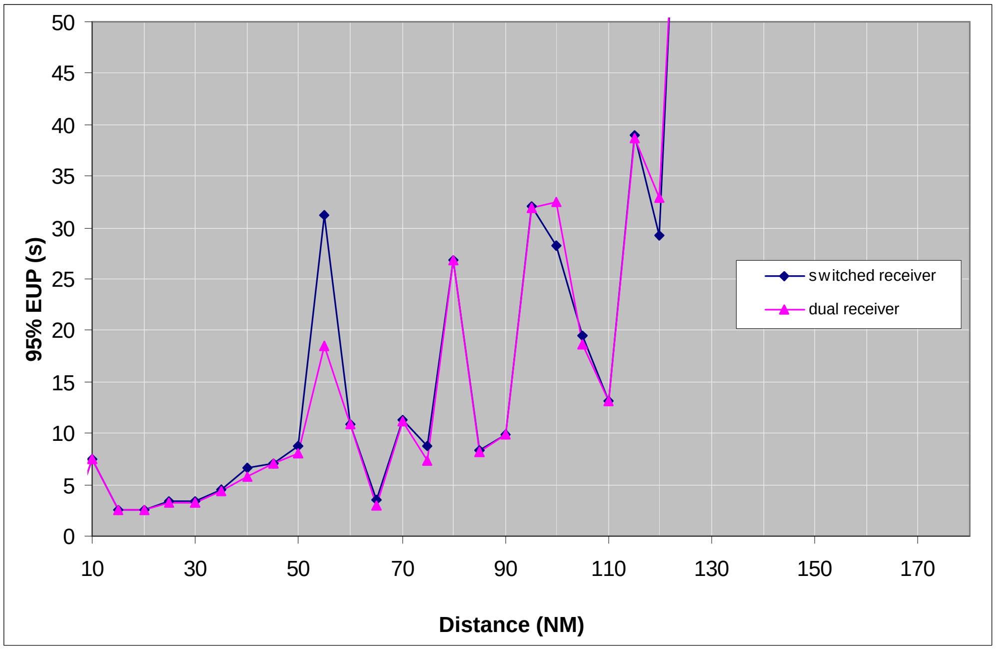


**Figure 4: Comparison of switched and dual receivers**

## Summary

This analysis has shown that the UAT is capable of meeting MASPS requirements for ADS-B applications for A3 aircraft.

Analysis of A0, A1 and A2 is approximate because the receiver configurations of these aircraft type were not accurately simulated. This analysis shows that A1 and A2 aircraft meet the MASPS requirements required of each aircraft type, but A0 does not meet them.

The use of a dual or switched receiver did not make a significant difference to the results.

Reasonable agreement was shown with the analysis undertaken by Eurocontrol Experimental Centre (EEC).