

**RTCA SC-209 and EUROCAE WG-49**

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**Real World 1030 Interrogation Rates Noted in the USA Northeast Corridor**

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**Summary**

The FAA conducted two flight tests over the US Northeast corridor and recorded the actual number of Mode A, C and S 1030 MHz messages that the test aircraft encountered. A review of this data noted that the current MOPS do not provide a minimum number of Mode S messages that a transponder must be able to process. Rather it only provides the minimum number of Mode S messages addressed to the unit under test that must be replied to. This paper also determined the number of Mode A, C and S 1030 MHz messages a transponder will likely be exposed to in the year 2020.

## 1. Introduction

The FAA conducted two flight tests over the USA Northeast corridor in 2006 and 2007 and recorded the actual number of Mode A, C and S 1030 MHz messages that the test aircraft encountered. Post flight analysis was conducted to better understand the actual number of Mode A, C and S messages that a transponder must process in the real world. A review of this data noted that the current Transponder MOPS do not provide a minimum number of Mode S messages a transponder must be able to process. Rather it only provides the minimum number of Mode S messages addressed to the unit under test that must be replied to. This paper also determined the number of Mode A, C and S 1030 MHz messages a transponder will likely be exposed to in the year 2020.

## 2 Discussion

Two recent FAA studies were prepared based on flights over the USA Northeast corridor in 2006 and 2007. The flights characterized the 1030 MHz and 1090 MHz environment in the USA National Airspace System (NAS). The details of these studies can be found in the Final Report on 1090 MHz Spectrum Congestion in 2035 and Performance of Systems Operating in the Band and the Final Report on the Analysis of Data Collected During Flight Tests in the Northeast Corridor of the United States In July 2007 at 1030 MHz and 1090 MHz. Among other things, these reports counted the overall number of RF transmissions and the number of interrogations that the test aircraft received as it flew through the USA Northeast corridor. The USA Northeast corridor extends from Washington DC to New York City.

A review of the 2007 flight data noted the peak rates for Mode A, C and S messages were:

- 535 Mode A and C interrogations per second<sup>1</sup>
- 1048 Mode S interrogations per second<sup>2</sup>
- 61 Mode S interrogations per second addressed to the aircraft under test<sup>3</sup>

This data is also summarized in Table 1 below.

A transponder that cannot perform properly under real world conditions may diminish safety, increase controller or pilot workload and possibly add pollution to the already congested 1030 and 1090 MHz frequencies. When compared to DO-181(), it was noted these values are higher than those called out in §2.2.3.4. It was also noted that while the Transponder MOPS call out the number of addressed interrogations a transponder must be able to respond to, it does not call out the total number of Mode S messages a transponder must process. These disparities increase the likelihood that a transponder may meet the MOPS requirements but not be able to perform its intended function in a real world environment. The Mode A, C and S rates being seen are higher

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<sup>1</sup> Figure 5.2.1-1: Unsuppressed Mode A Interrogations, page 6, Final Report on the Analysis of Data Collected During Flight Tests in the Northeast Corridor of the United States In July 2007 at 1030 MHz and 1090 MHz, 24 Aug, 2010

<sup>2</sup> Paragraph 5.4.2, page 9, Final Report on the Analysis of Data Collected During Flight Tests in the Northeast Corridor of the United States In July 2007 at 1030 MHz and 1090 MHz, 24 Aug, 2010

<sup>3</sup> Para 9.1.2 last paragraph on page 49, Final Report on the Analysis of Data Collected During Flight Tests in the Northeast Corridor of the United States In July 2007 at 1030 MHz and 1090 MHz, 24 Aug, 2010

than the rates called out in the MOPS. It can be assumed that this situation will get worse as aircraft density increases over time.

To estimate the future peak rates, the values noted in the July, 2007 flight test were multiplied by a rate of 1.7% per year out to the year 2020<sup>4</sup>. This provides an estimated number of interrogations that a transponder will likely be exposed to if it flies through the USA Northeast corridor in 2020. These values are summarized in Table 1 below.

Comments	Current MOPS values	Rates noted July 2007	Estimated rates in 2020
Growth rate used to calculate 2020 estimates <sup>5</sup>	---	---	1.7%
Number of Mode A / C interrogations per second	500	535	666
Number of Mode S interrogations per second in the air space	---	1048	1305
Number of Mode S interrogations per second specifically addressed to transponder	50	61	76

**Table 1 - MOPS, 2007 and projected 2020 interrogation values**

### 3 Recommendations

Based on the above findings it is recommended that RTCA SC-209 and EUROCAE WG-49 develop a standard for the total number of Mode S messages that a transponder must be able to process. Furthermore it is recommended that the Joint committees ensure that transponders perform their intended function in the NAS until at least 2020 by creating a test that accurately reflects the peak interrogation environment that a transponder will be exposed to based on the real world data recorded by FAA.

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<sup>4</sup> Para 5.1.3, page 42, Final Report on 1090 MHz Spectrum Congestion in 2035 and Performance of Systems Operating in the Band, August 28, 2009