

**RTCA Special Committee 186, Working Group 3**

**ADS-B 1090 MOPS, Revision A**

**Meeting #13**

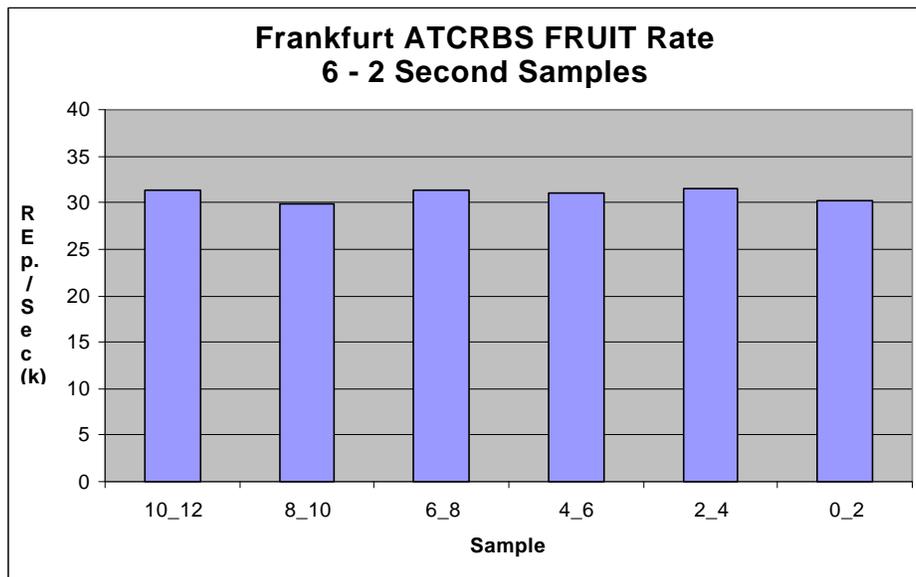
**ATCRBS Time Distribution Summary**

**Presented by Thomas Pagano**

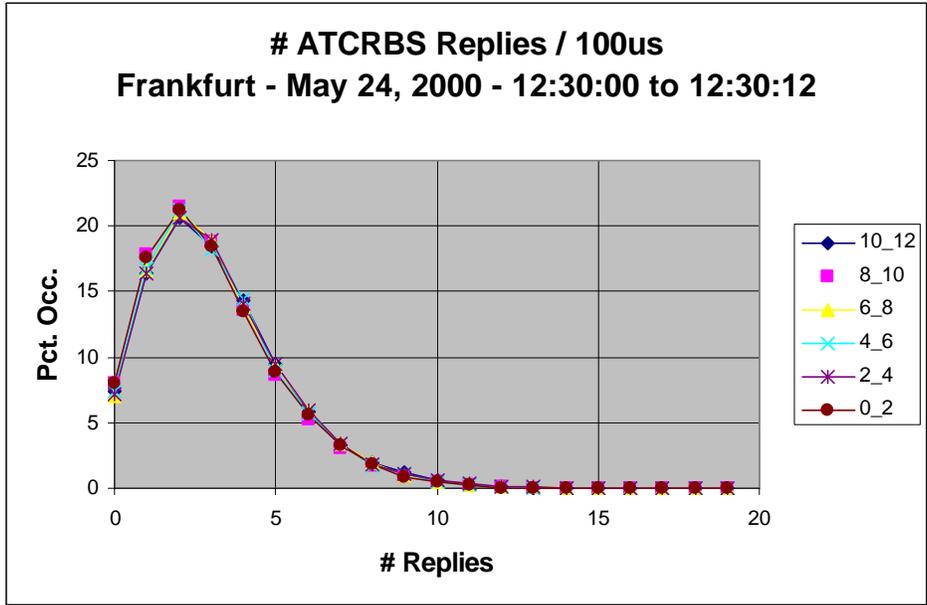
<b>SUMMARY</b>
The following data summarizes the time distribution of ATCRBS replies measured from a sample of the Frankfurt environment from May 2000 flight tests and a sample from an East Coast environment flight test in September 2001. The analysis was performed to validate the timing distribution that will be utilized in Extended Squitter performance measurement models.

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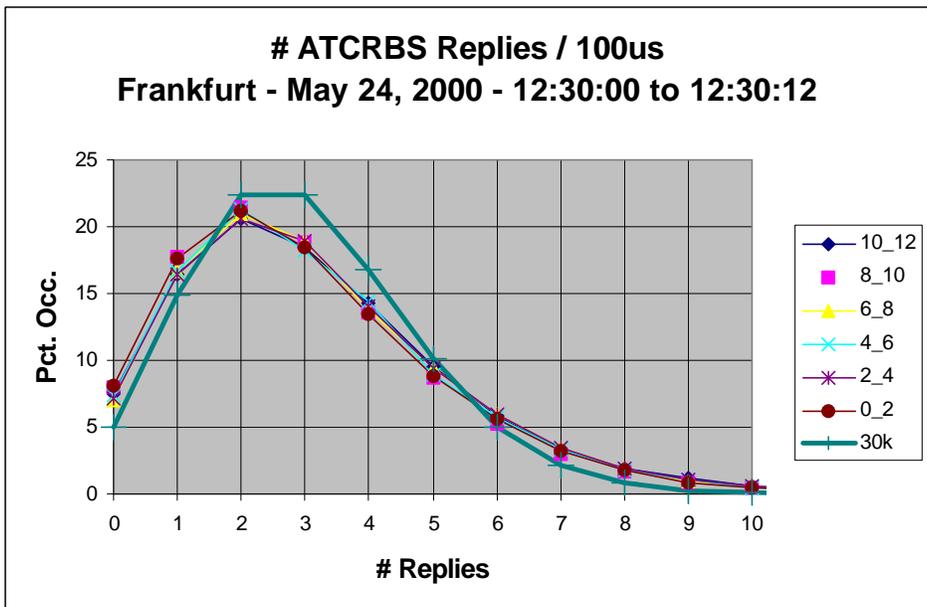
A sample from a flight during the Frankfurt ADS-B flight trials when ATCRBS Fruit rates were at peak values was selected. The results from the selected Frankfurt sample are shown herein. The sample analyzed was taken for a 12 second time interval. The data from the first plot is the average ATCRBS rate at -84 dBm and above over each of the 6 - 2 second interval. The advantage of the sample taken is that the rate was fairly constant so that the values to calculate the Poisson distribution are not subject to variations.



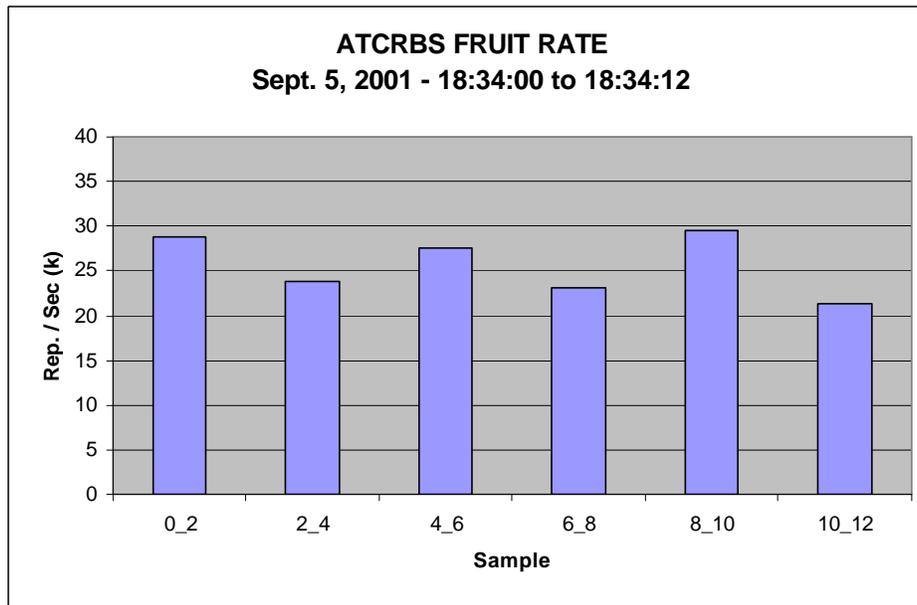
As can be seen from the plot, the average ATCRBS rate is approximately 30,000 replies per second. The second plot represents the percent distribution of the number of replies occurring in 100 microsecond intervals. The x - axis represents the number of replies in a 100 microsecond interval and the y - axis represents the percentage of 100 microsecond intervals containing that number of replies. As can be seen from the plot, the distribution is consistent over the 12 second interval for each of the 2 second samples.



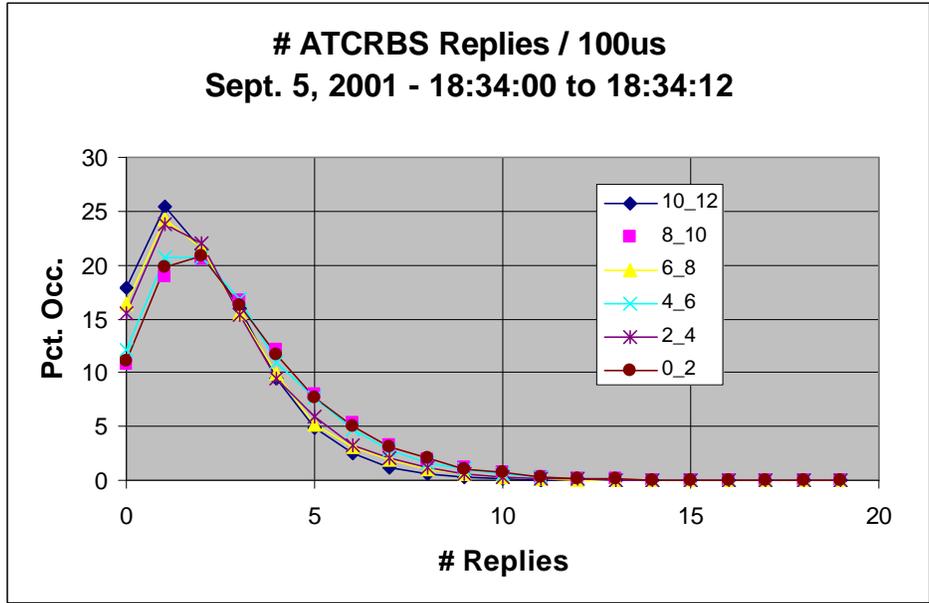
The next plot includes the Poisson distribution for the average reply rate over the data sample, which is approximately 30K per second. As can be seen from the comparison, the measured data does not exactly map to the distribution predicted by Poisson. There is a slight skew that indicates that measured arrivals may tend to bunch ever so slightly. Whether this is due to lack of adequate samples or is a real behavior is hard to determine without further analysis. However, the conclusion can be made that the measured data closely correlates a Poisson distribution.



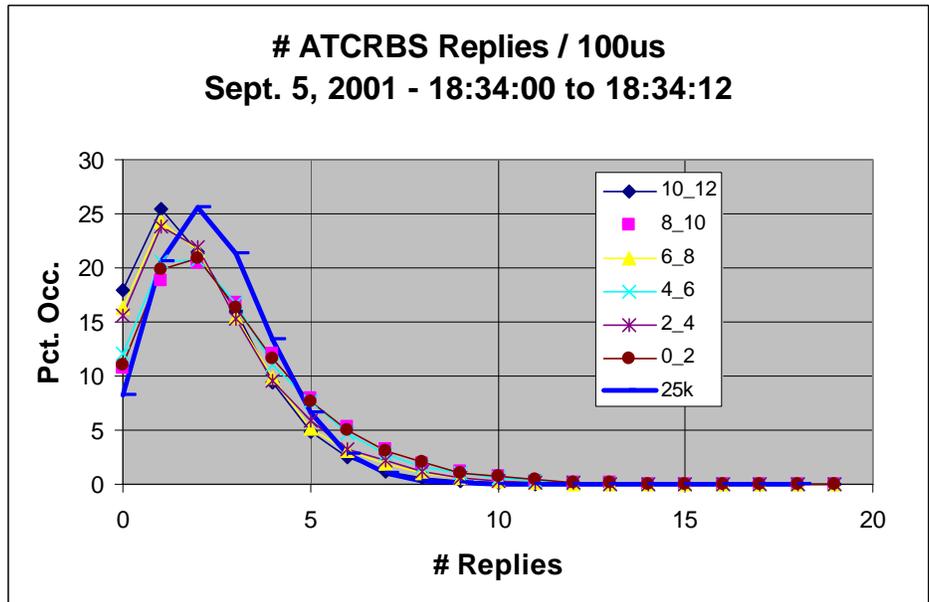
The following data was collected from a flight conducted on the East coast to measure ATCRBS and Mode S reply rates. The sample evaluated here was taken during a measurement flight conducted September 5, 2001. The flight profile took the aircraft from the Atlantic City area, north to New York reversing to the south to as far as Washington, DC and returning to Atlantic City. The data sample analyzed herein was when the aircraft was located between Philadelphia and Baltimore. Each sample represents 2 seconds from an overall sample of 12 seconds and represents the ATCRBS reply rates having amplitudes of  $-84$  dBm and above. As shown in the following plot, the data variation is greater than that experienced from the 12 second sample analyzed from the Frankfurt environment.

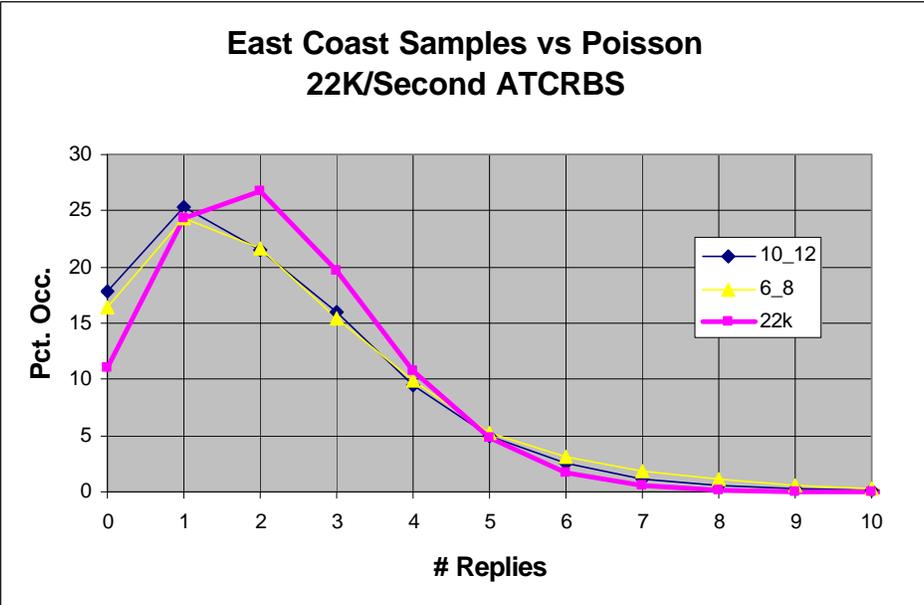
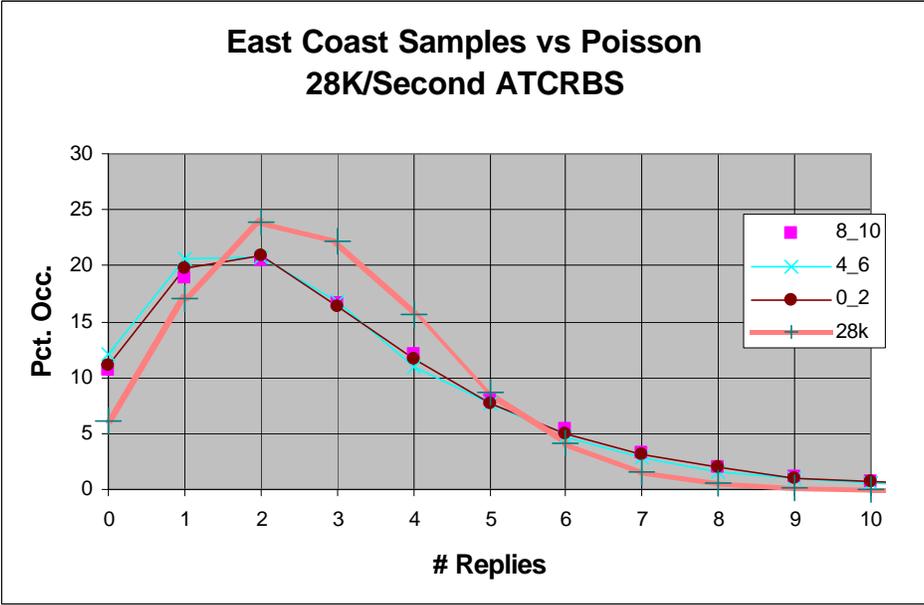


The second plot depicts the percent distribution of number of replies in a 100 microsecond time interval for each of the 6 – 2 second samples.



The next plot depicts the distribution along with the Poisson distribution representing the average rate for the 12 second interval. Since the data varies from the first 2 second interval to the last, the data can be compared against the Poisson distribution from the overall average of the full 12 seconds or the average corresponding to the individual 2 second interval. The final 2 plots show comparisons to the Poisson distribution of the average rate for the individual 2 second samples.





The comparison using either method yields a similar conclusion. The data sample timing distribution shows the general shape of a Poisson distribution. The East Coast sample shows a bias to “bunching”, more so than the Frankfurt data sample.