

Low Level Mode S Interrogations

SC-209

February 11-14, 2008

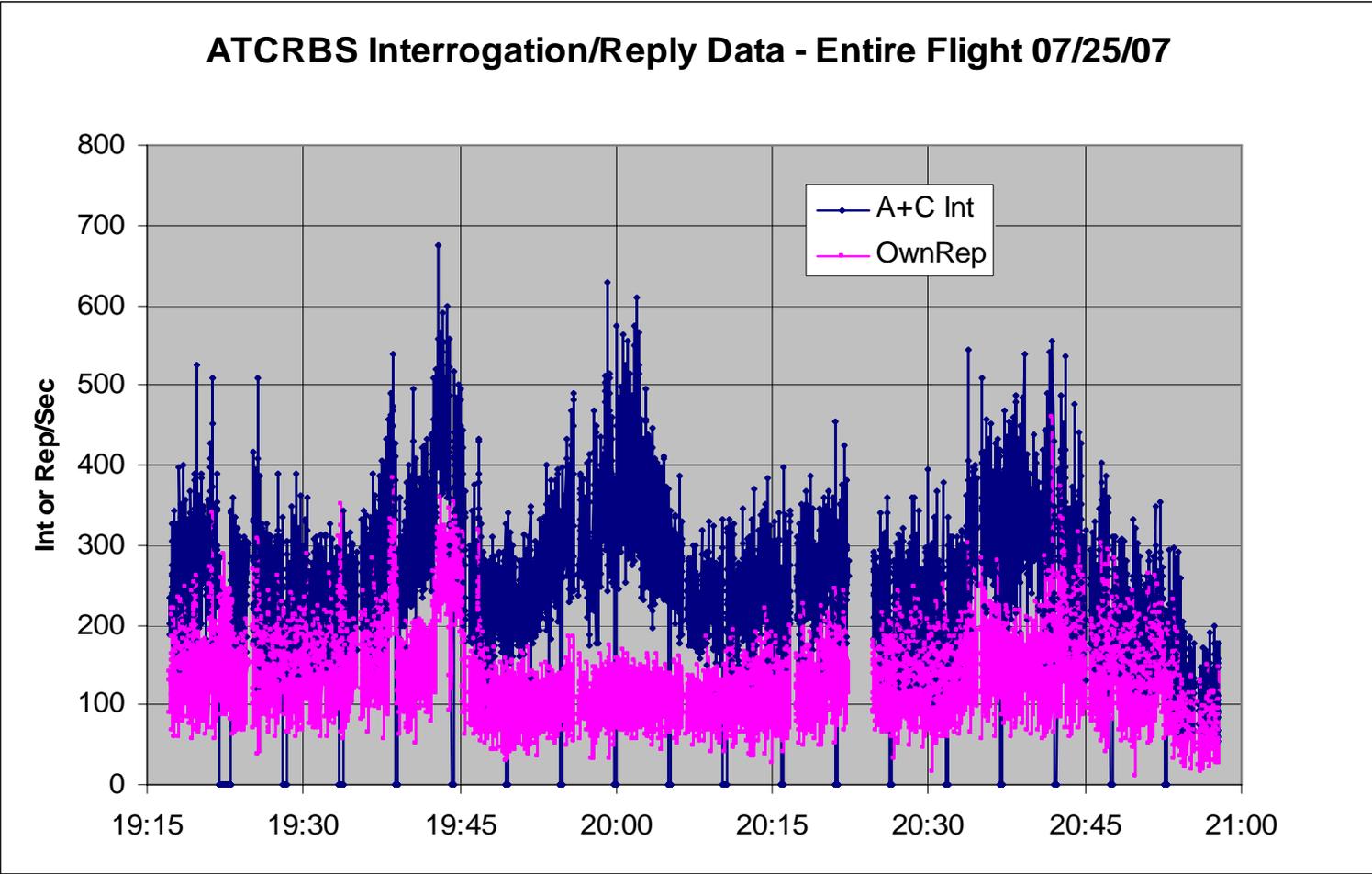
Background

- Flight test data presented at the February 2008 Technical Subgroup (TSG) meeting presented data that shows Mode S transponders answering low level Mode S interrogations with Mode A replies
- TSG recommended consideration of this issue at the joint SC-209/WG-49 meeting this week
- Next few slides are from the TSG flight test briefing last week

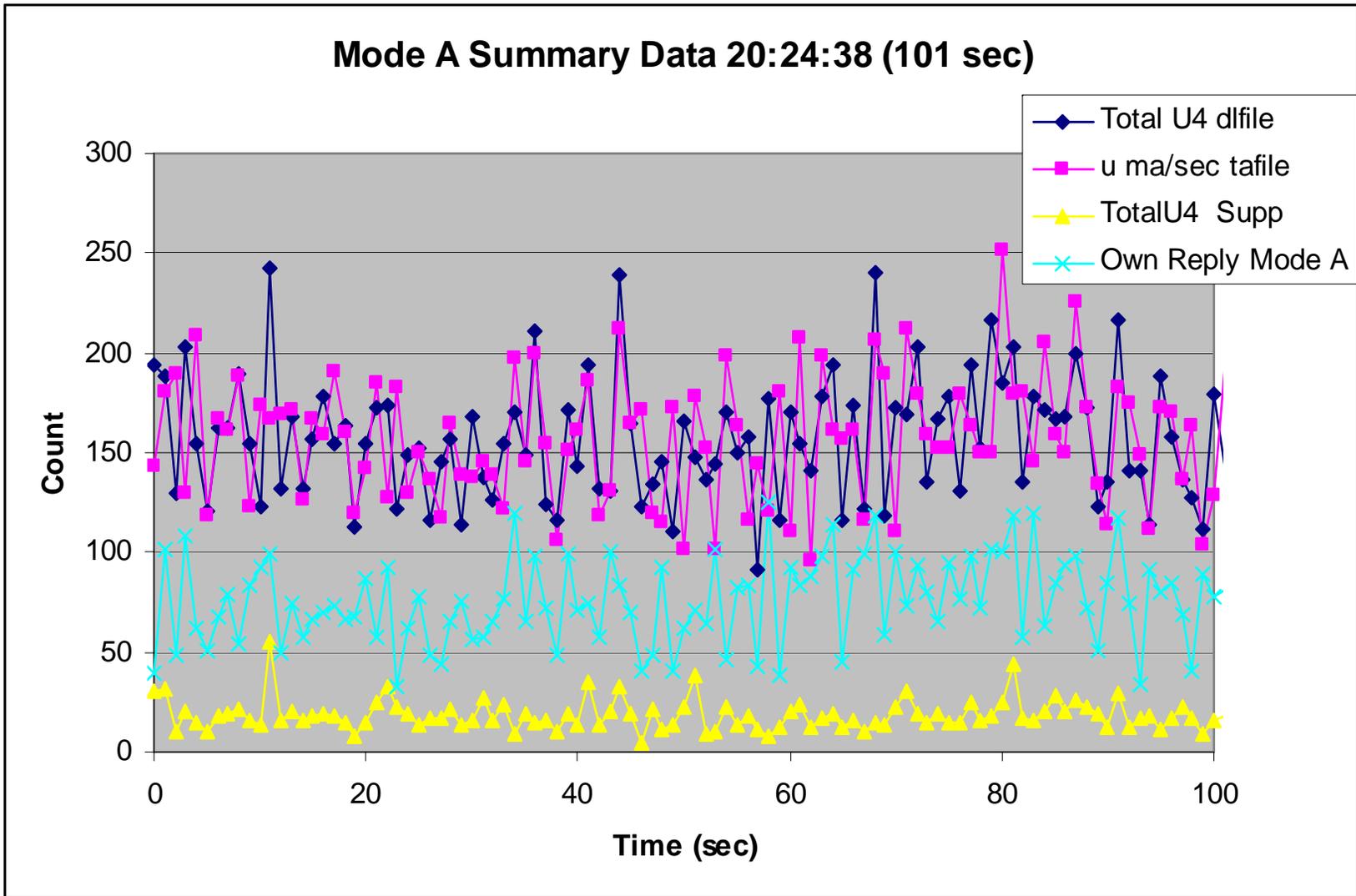
TSG Slide 4 - Observations

- Unsuppressed ATCRBS Mode A interrogation measured counts are higher than what are present in the environment
- Analysis indicates that the DATAS front end interrogation decoder creates ATCRBS Mode A interrogations from the P6 of low level Mode S interrogations
 - Data validation of interrogation counts performed by comparing own ship transponder ATCRBS reply counts with interrogation counts from DATAS. Counts are expected to be comparable except accounting for transponder unavailability to reply (transponder in suppression, recovery or reply cycle)
 - DATAS detects interrogations with a modified Mode S transponder
 - Own ship Mode A counts were significantly lower for this flight test
 - Comparison between DATAS ATCRBS interrogation count and on-board transponder ATCRBS reply count for the January 2006 flight test showed good agreement
 - Mode A interrogation counts will be adjusted upon determining percentage that can be attributed to this characteristic
 - Additional analysis is included later in this briefing

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Total ATCRBS Interrogations
and Ship Transponder ATCRBS Replies



TSG Slide 37
Mode A Interrogation / Own Reply Sample



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ATCRBS Interrogation Rate Analysis (1)

- Detailed sampled video from the DATAS 1030 MHz receiver was analyzed to determine possible causes of the extra ATCRBS interrogations detected
- Analysis indicated that there were many occurrences of declared ATCRBS Mode A decodes from low amplitude Mode S interrogations.
 - The Mode S interrogation was missed by the transponder front end and the DPSK modulated P6 created lead edge pulse opportunities
 - Given the 16.25 microsecond width of the short P6 of a Mode S interrogation, ATCRBS Mode A decodes can be decoded

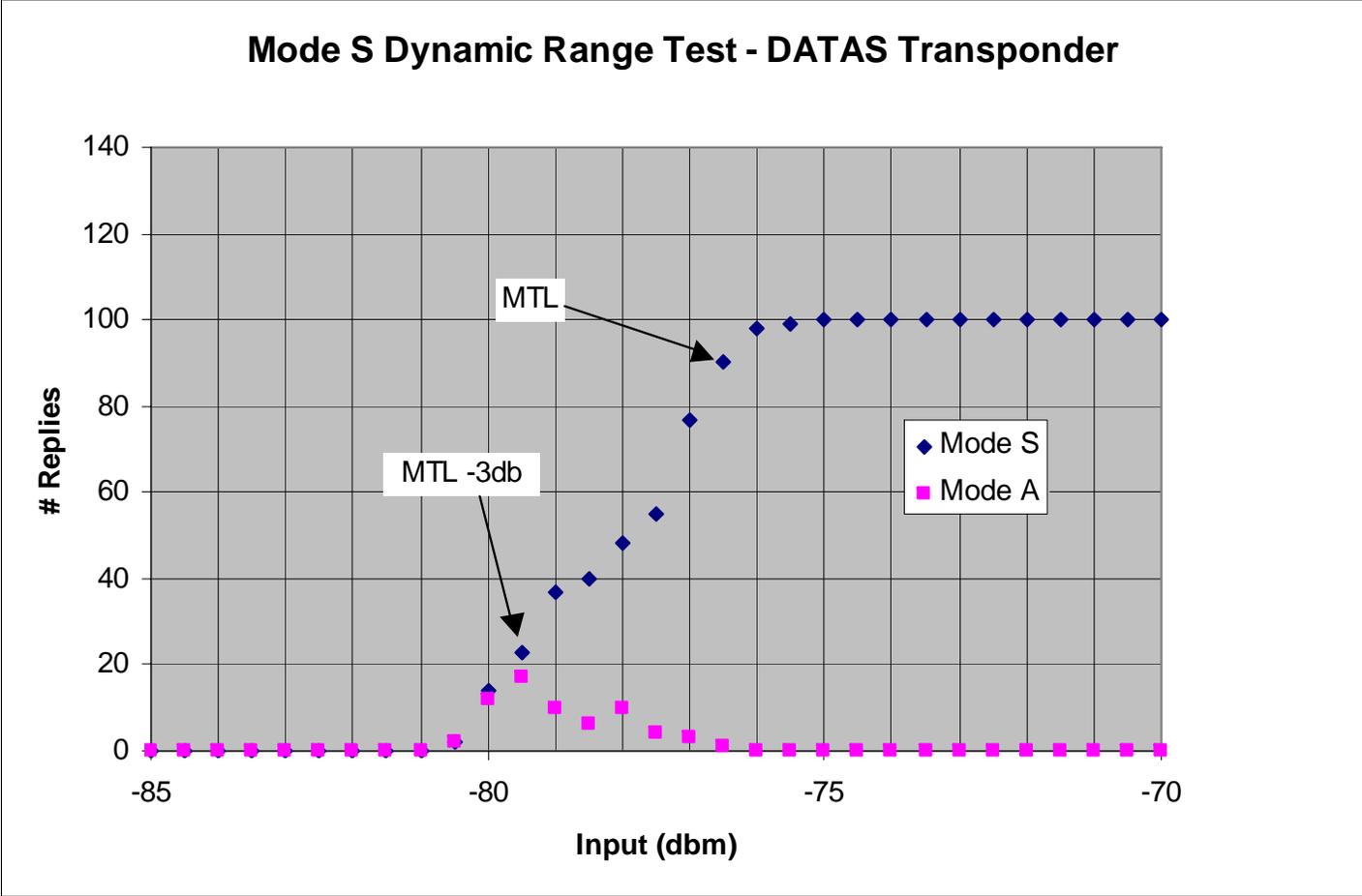
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ATCRBS Interrogation Rate Analysis (2)

- Several transponders were tested to determine low level Mode S interrogation characteristics, including both January 2006 and July 2007 ship transponder and DATAS data collection transponder
- July 2007 ship Mode S transponder did not exhibit the characteristic of detecting ATCRBS interrogations from low level Mode S interrogations (less than 1 per 100)
- Mode S transponder model from January 2006 flight test exhibited behavior similar to the transponder front end of DATAS.
 - May explain the ATCRBS interrogation rate agreement between DATAS and the flight test on-board transponder
- Another manufacturer model Mode S transponder was tested and did not exhibit the characteristic.

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Mode S Interrogation Characteristics of DATAS

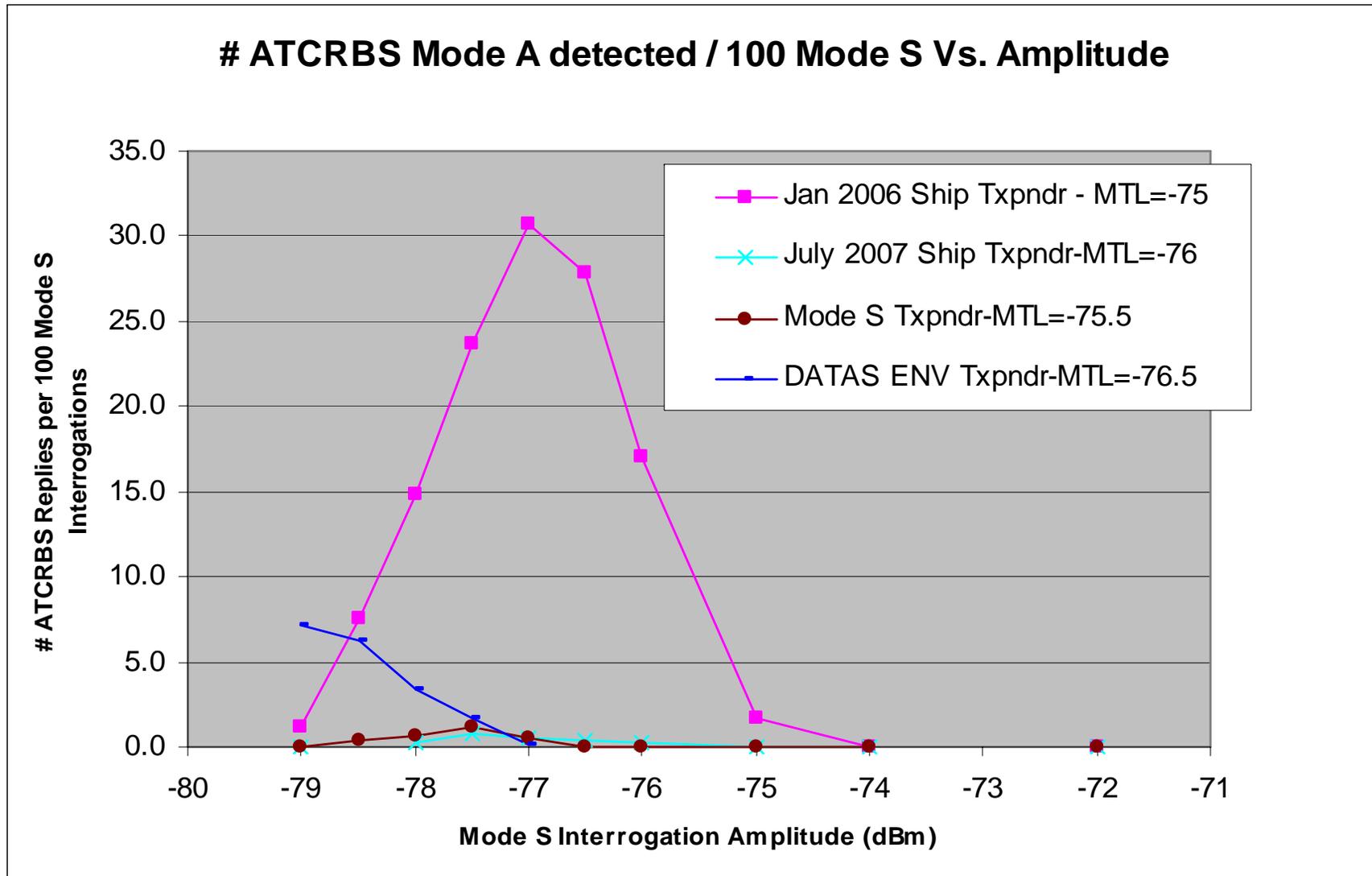


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Summary

- Data analysis continuing to complete flight test measurements.
- PRT analysis to identify individual SSRs continuing.
- Observation that low level Mode S interrogations are decoded as ATCRBS interrogations is a concern. Impact to 1090 MHz interference can be significant since many low level Mode S interrogations are a result of high density TCAS activity. The immunity of some transponders to this characteristic and the tendency of others to exhibit the characteristic may be related to front end design.
 - SCRSP/WG-B WP B10-14 dated April 25, 2006, Issues on P1/P2 and Mode S Preamble detection, contains a discussion of the characteristic. The WP does not discuss the interference effects.
 - Further testing and analysis is intended by the FAA.
- Reported ATCRBS interrogation rates from January 2006 and July 2007 flight tests are inflated due to above characteristic. Measured rates would be that seen by a transponder with the above characteristic. ATCRBS rates from Ground interrogators are better represented by the onboard Mode S transponder ATCRBS reply rates.

Bench Test Results of Tested Mode S Transponders



Proposed Requirement for Mode S Transponder MOPS

- Mode S interrogations with power levels from 3 dB above MTL to -81 dBm shall not generate more than 1 % ATCRBS replies at any of these levels.

Note: Low level Mode S interrogations that are not detected as a Mode S interrogation may be incorrectly decoded and replied to with ATCRBS replies.