RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS

Meeting #6

UAT/JTIDS Co-site Performance

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SUMMARY

In response to Action Item 5-7, this paper investigates the performance of a UAT ground receiver in an environment generated by a cosited JTIDS transmitter.

This paper addresses the performance of a UAT ground receiver in the presence of a JTIDS interferer in a co-site situation. In the scenario defined by Action Item 5-7, a JTIDS transmitter is in close proximity to the UAT receiver and has a 50% time slot duty factor (TSDF). The scenario also includes a second JTIDS transmitter, occupying the remaining 50% of the time slots, being received at a level of –60 dBm.

If the separation between the co-sited JTIDS transmitter and the UAT receiver is 1000 feet, then the isolation between the two is –82 dB. This number is based on free-space propagation and assumes the antennas are isotropic. If that is the case and the power of the JTIDS transmitter is 200 watts, then the received JTIDS level is –29 dBm. However, it is possible that the separation is smaller and/or there is some antenna gain to be taken into account. (In previous modeling the ground UAT station was presumed to have a 7 dB gain.) Thus, the isolation value is taken to be a free parameter, and the graphs below each show curves for isolation values ranging from –62 dB to –82 dB.

Since the value of the IF filter bandwidth of the UAT receiver has not yet been chosen, two sets of curves are presented. Descriptions of the two potential filters and the equations used to model their performance can be found in UAT-WP-5-08. The receiver is presumed to be receiving long ADS-B messages transmitted at a power level of 25 watts. Figures 1 and 2 show the long ADS-B failure rates as a function of UAT distance for the two filter possibilities. In both cases there is a plateau in the curves when the isolation is –62 dB or –72 dB. This plateau phenomenon can be explained if it is assumed that just about any overlap between a 258-pulse JTIDS message from the nearby JTIDS transmitter and the UAT message will result in an error. The probability of this happening can be estimated by

$$0.5 \times 128 \times 258 \times 13 \times 10^{-6} = 0.215 .$$

This is approximately equal to the level of the plateaux. At longer distances the second JTIDS interferer comes into play and the failure probability rises.

The curves in figures 1 and 2 assume that the UAT transmitted ERP is 25 watts and that the receiver antenna has 0 dB gain. On the other hand, there may be a range of transmitter powers and it is quite likely that the ground antenna will have some gain. If, for example, the ground antenna has 7 dB gain, it will seem as if the transmitted ERP is 125 watts. Figures 3 and 4 show the performance curves for a 125 watt UAT transmitter. The plateau phenomenon reappears, but is shifted to longer ranges. Indeed, it is easy to see that the effect of changing power or gain is to rescale the horizontal axes. The curves of figures 3 and 4 could have been derived from figures 1 and 2 by shifting the curves to the right by a factor of $\sqrt{5}$.

Note that over the range of failure rates featured in both sets of curves, the performance with the wide filter is somewhat better than the performance with the narrow filter. This may be a factor in the choice of filter bandwdth.

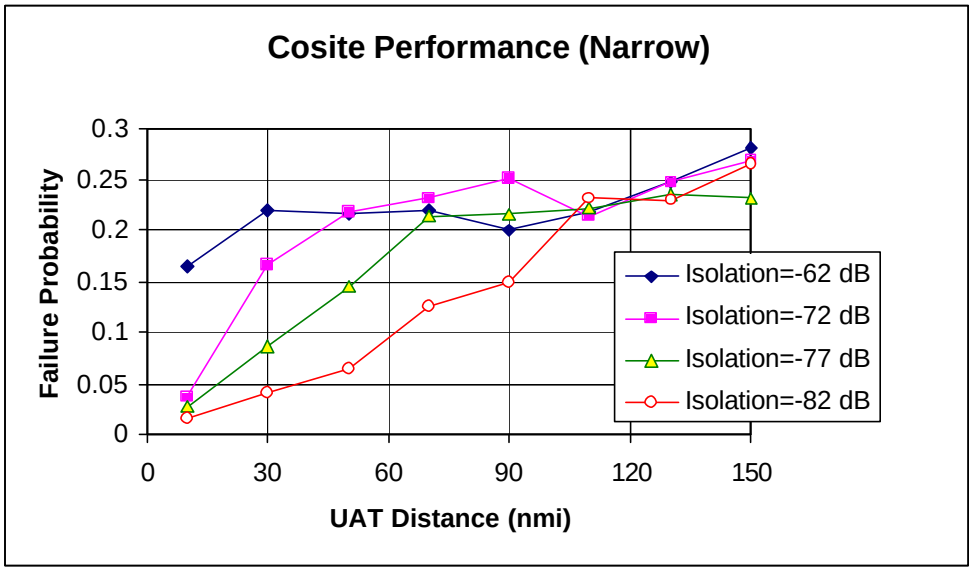

Figure 1. UAT/JTIDS Co-site Performance with Narrow IF Filter
UAT Power = 25 Watts

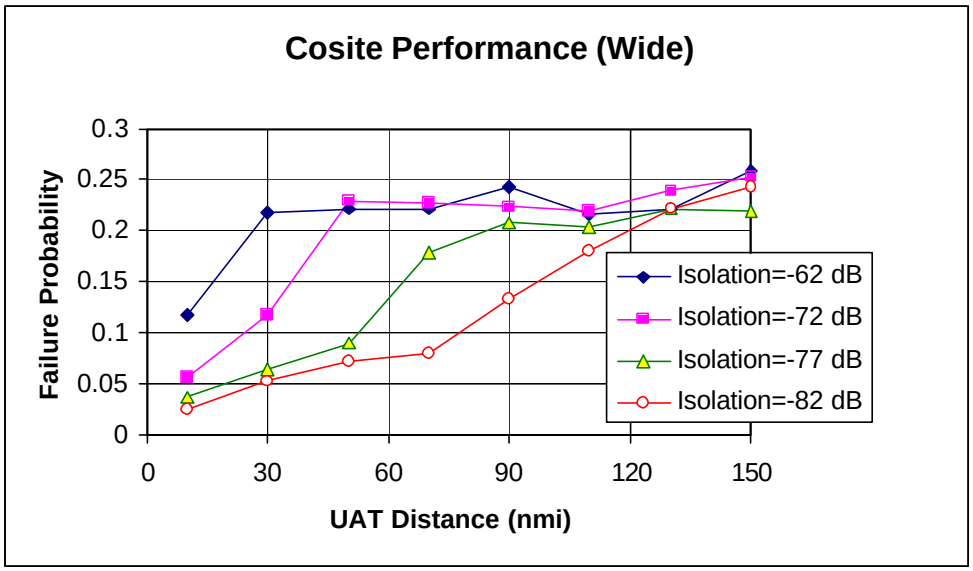

Figure 2. UAT/JTIDS Co-site Performance with Wide IF Filter
UAT Power = 25 Watts

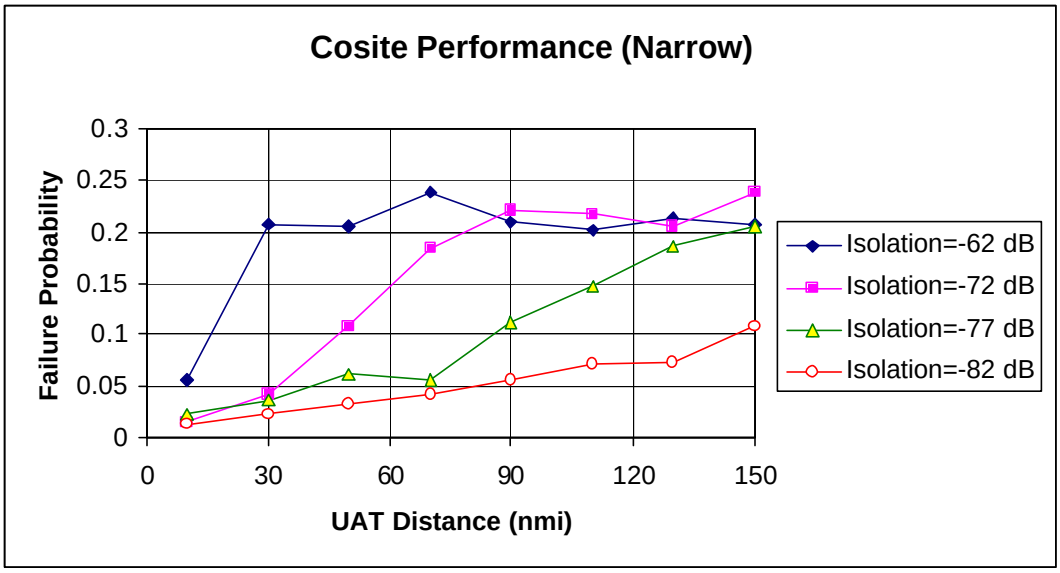

Figure 3. UAT/JTIDS Co-site Performance with Narrow IF Filter
UAT Power = 125 Watts

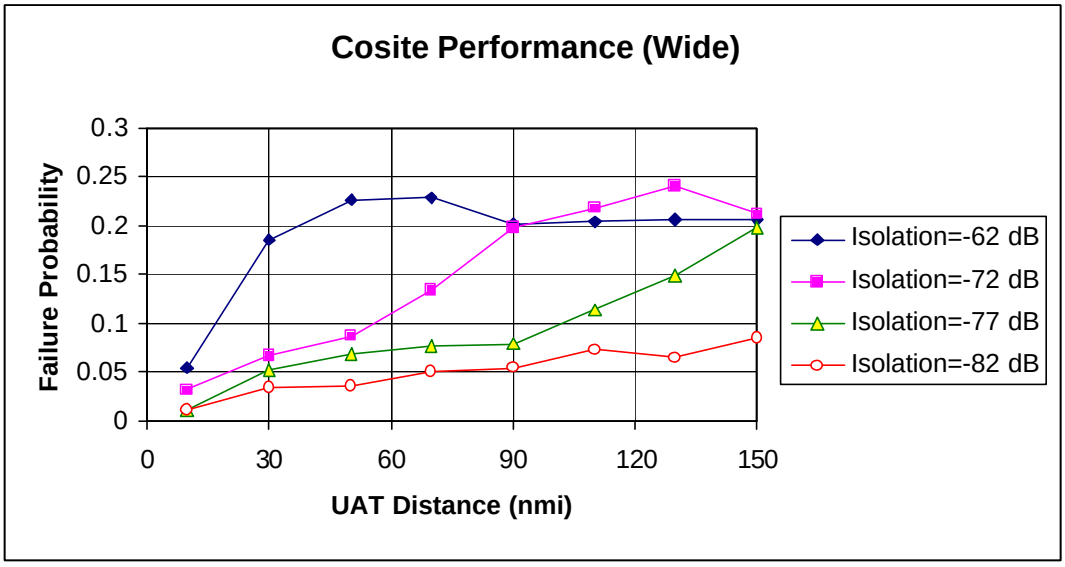

Figure 4. UAT/JTIDS Co-site Performance with Wide IF Filter
UAT Power = 125 Watts

In summary, the graphs appear to show that the performance degradation due to co-sited JTIDS interference sources may be acceptable if the isolation is –82 dB or better. If the isolation is –72 dB or worse, the degradation may be too large. Without a clear definition of the requirements for this UAT application, it is difficult to make a more precise statement; however, it does seem clear that co-site operation will require careful antenna siting and/or large sites.