Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Coexistence Same Area Simulations at 10.5 GHz (Outbound)**
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Re:	Coexistence C/I Simulation Estimates in Support of 802.16a System Design
Abstract	This document examines outbound C/I estimates at 10.5 GHz. It identifies the distance separation between CS locations for which coordination may be required between system operators. The relative rain attenuation between victim and interference links is examined. The impact of a interference mitigation between multiple operator frequency assignments is also considered. The conclusions are specific to the system model selected. Other system model parameters may modify the distance coordination requirements.
Purpose	This document is provided to TG2a for consideration and inclusion in the amended Coexistenc Practice Document for PMP systems operating below 11 GHz.
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Coexistence Same Area C/I Simulation

Estimates at 10.5 GHz (Outbound)

1.0 Introduction

A previous contribution [1] identified typical system and equipment parameters viewed to be appropriate to 10.5 GHz. A second contribution [2] described the Monte Carlo simulation methodology for examination of clear sky 3.5 GHz C/I estimates for multiple adjacent frequency operators. For comparable clear sky operation at 10.5 GHz, all that is required is to modify the system and equipment parameters of [2] to those given by [1]. For examination of the impact of relative rain attenuation at 10.5 GHz on C/I, a contribution [3] has been developed that describes the computational methodology. The reader is referred to these contributions for details of the simulation model and methodologies.

2.0 Simulation Results

Previous studies have indicated that 16-QAM can be supported in the outbound direction. As previously assumed, this places threshold C/N at 18 dB and a 1 dB threshold C/I at 24 dB. Victim subscribers are set based on an area proportional random location. Maximum cell radius R is set to 7 km and all interference/signal vectors are assumed to be LOS.

2.1 Clear Sky

2.1.1 Zero Guard Band - Same Polarization

As before, NFD without a guard band is assumed to be 27 dB. Figures 1 and 2 report the results of the simulations. Figure 1 illustrates the results for a CS separation distance of S < 2 km while Figure 2 illustrates the results for S > 3 km.

While the results exhibit the same general characteristics as those reported for 3.5 GHz [2], there is a noticeable improvement. This is a direct result of the improved RPE of the TS antenna. At the performance threshold level of 18 dB, only a fractional number of exposures < 1% are in excess of threshold. There are no more than 3 % of the exposures that exceed the 1 dB threshold impairment level of 24 dB.

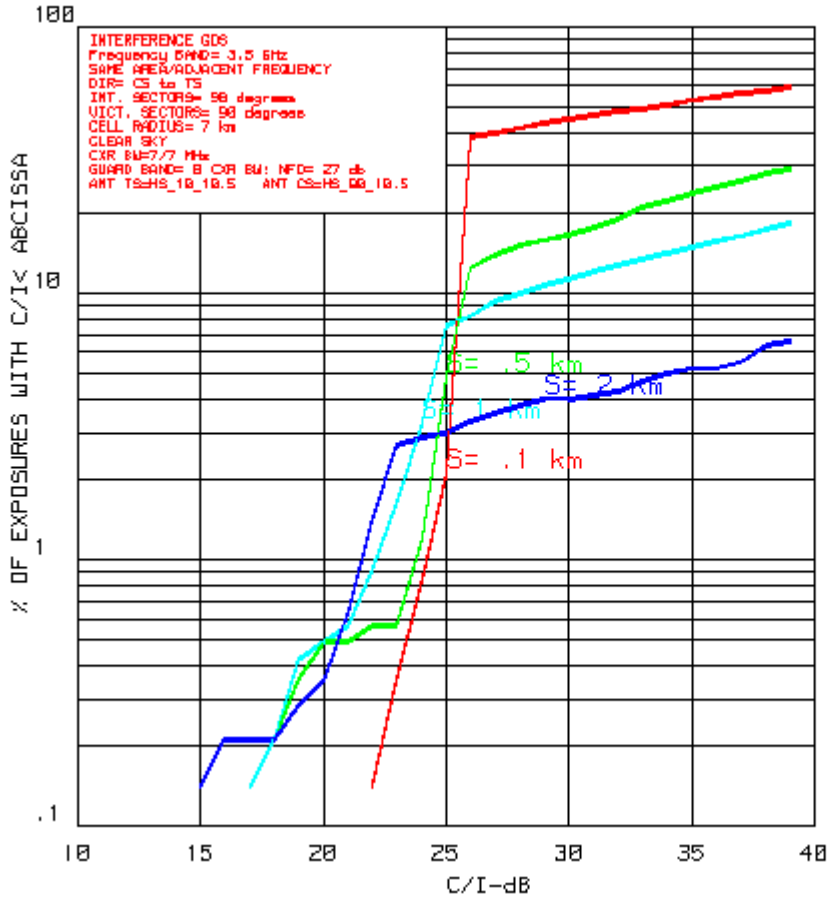

Figure 1. CDF for Zero Guard Band and Same Polarization (S < 2 km)

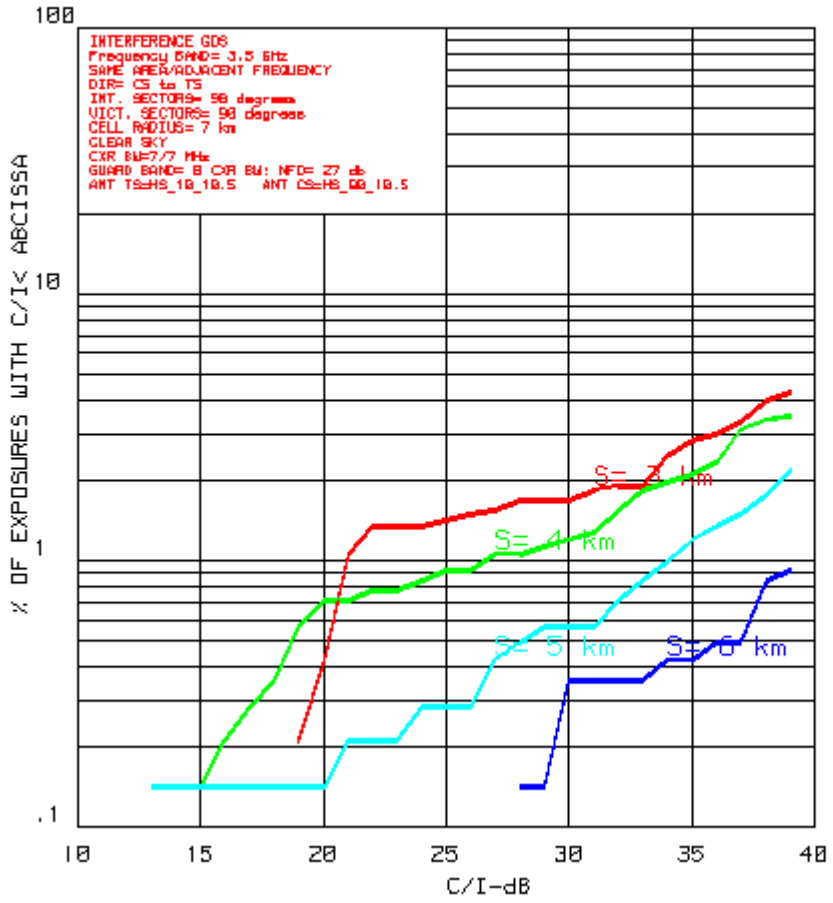

Figure 2. CDF for Zero Guard Band and Same Polarization (S > 3 km)

2.2 Rain Faded

2.2.1 Zero Guard Band - Same Polarization

In [3], it was identified that a rain attenuation margin of 7 dB would be required to meet a 99.99 % availability objective in ITU-R rain region K. Using the rain fade computational methodology described in [3], the simulation results are illustrated on Figures 3 and 4. When compared against Figures 1 and 2, it is apparent that the rain attenuation differential between interference and victim paths has resulted in a noticeable increase in the probability of critical value C/I.

While the degradation is not debilitating, some form of interference mitigation is clearly desired. While forced coordination (say a polarization change by one operator), or a guard band, eliminate the problem, neither are desirable. A much simpler solution would be to argue for improved NFD in the first adjacent channel. A modest improvement from 27 to 35 dB would negate the problem.

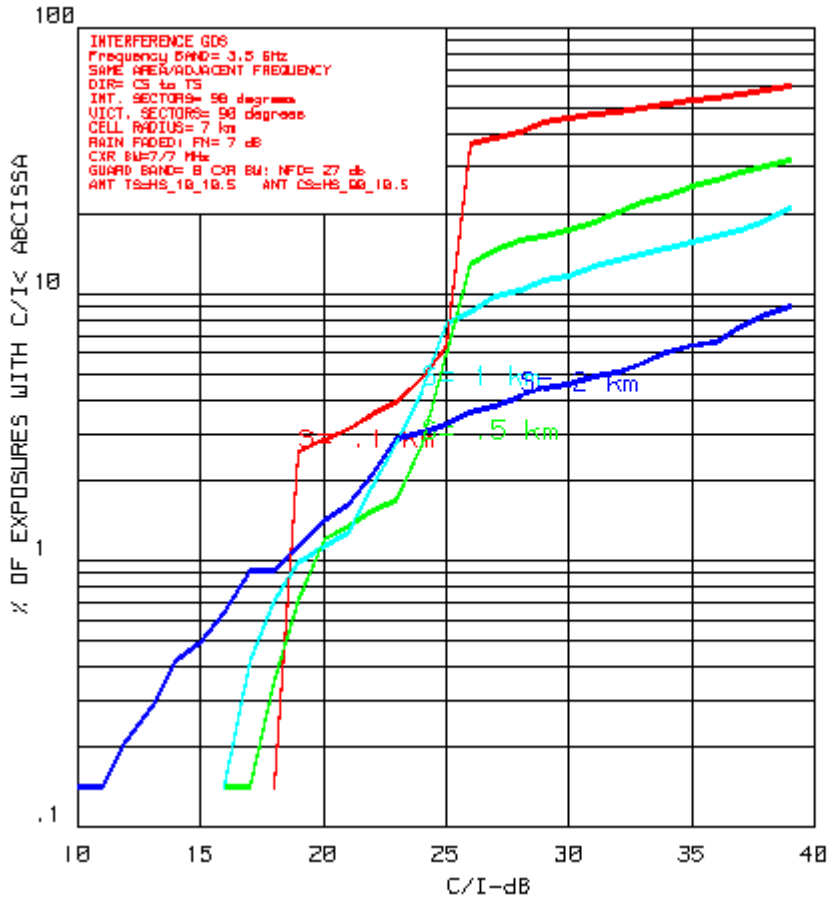

Figure 3. Rain Region K CDF for Zero Guard Band and Same Polarization (S < 2 km)

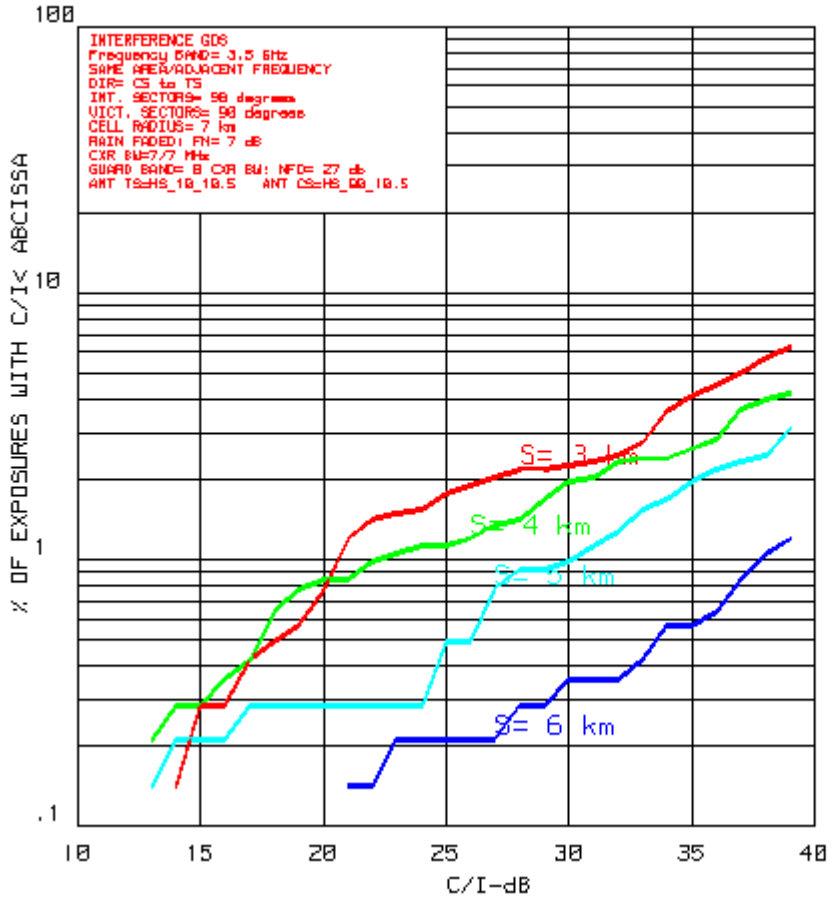

Figure 4. Rain Region K CDF for Zero Guard Band and Same Polarization (S > 3 km)

Due to the extreme magnitude of rain attenuation at EHF frequencies in tropical and sub-tropical locations, PMP operation at sub-11 GHz is obviously to be preferred. Figures 5 and 6 illustrate the simulation results for ITU rain region P that require a 16 dB fade margin [3]. The performance is further degraded. However, we can again note that improved NFD would be sufficient to resolve most of the issues. A caveat remains, CS distance separation < 500 m would still be questionable.

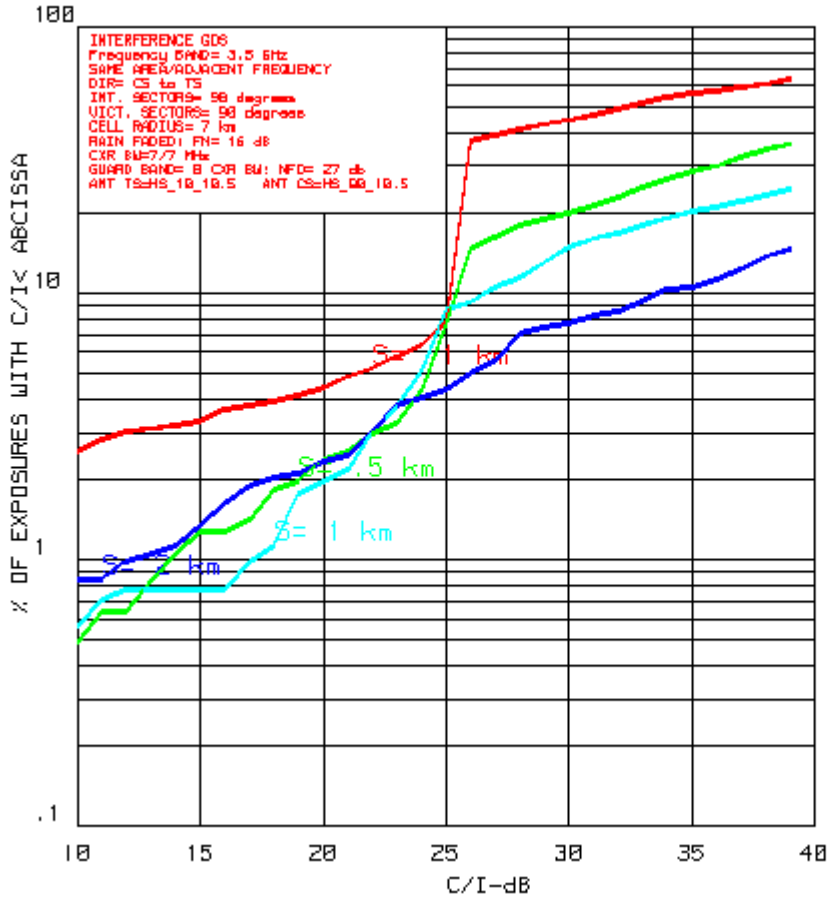

Figure 5. Rain Region P CDF for Zero Guard Band and Same Polarization (S < 2 km)

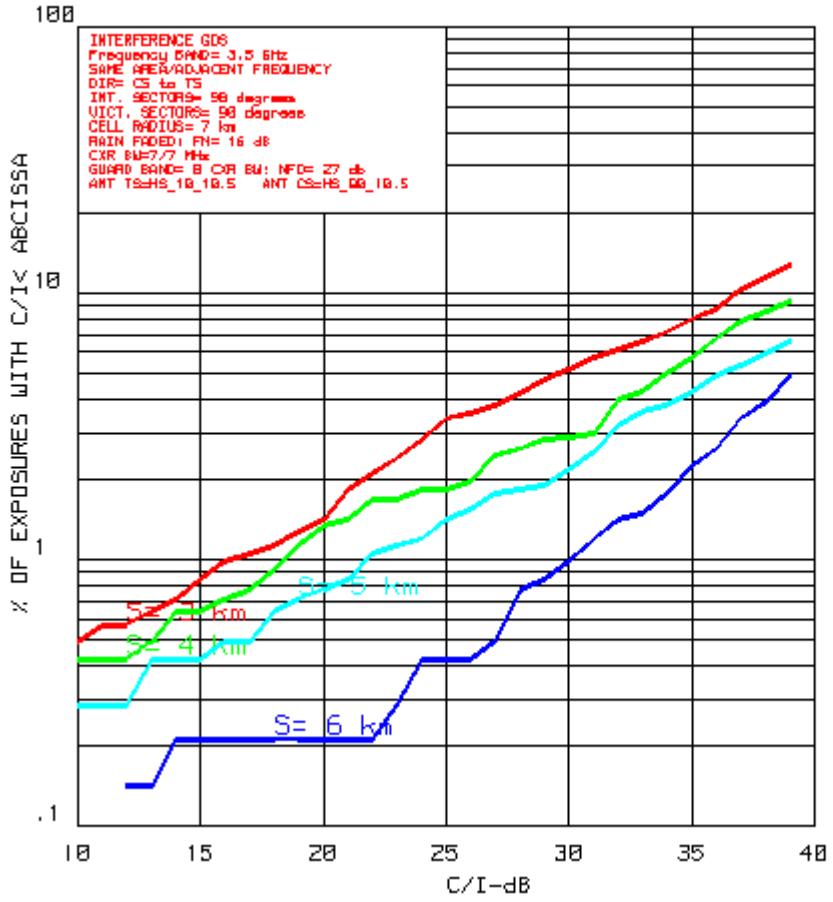

Figure 5. Rain Region P CDF for Zero Guard Band and Same Polarization (S >3 km)

3.0 Summary

In the preceding, we have examined outbound CS to TS interference for both clear sky and rain faded conditions. For the latter case, some form of modest interference mitigation is desired. The simplest solution would be to improve the NFD by a modest amount from 27 to 35 dB. This improvement may already be available for some transmitter designs. For others, it may require an increase in OBO.

4.0 References

[1] Coexistence Co-Channel Boundary pfd Simulations at 10.5 GHz (Inbound), Revision 1, G. Jack Garrison, IEEE C802.16.2a-02/01r1.

[2] Coexistence Same Area Simulation Estimates at 3.5 GHz (Outbound), G. Jack Garrison, IEEE C802.16.2a-02/07.

[3] A Simplified Method for the Estimation of Rain Attenuation at 10.5 GHz, G. Jack Garrison, IEEE C802.16.2a-02/15.