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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>** |
| Title | **Coexistence Same Area C/I Simulation Estimates at 10.5 GHz (CS to CS)** |
| Date Submitted | **2002-04-25** |
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| Re: | Coexistence C/I Simulation Estimates in Support of 802.16 TGa Systems Design |
| Abstract | This document examines base station to base station interference couplings at 10.5 GHz. Both clear sky and rain faded scenarios are examined. |
| Purpose | This document is provided to TG2a for consideration and inclusion in the amended Coexistence Practice Document for PMP systems operating below 11 GHz. |
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# Coexistence Simulation C/I Estimates at 10.5 GHz (CS to CS)

## 1.0 Introduction

In a companion contribution [1], same area CS to CS interference was examined at 3.5 GHz. This contribution examines interference at 10.5 GHz. Here, the impact of the relative rain attenuation differential between interference and victim links must be considered. The methodology for estimating rain loss is described in [2],[3]. Herein, we examine rain attenuation for ITU-R rain regions K and P.

Transmission parameters for 10.5 GHz are those as described in [4]. Inbound victim links are assumed to operate at 4-QAM. Consequently, performance threshold is assumed to a C/N = 12 dB and a 1 dB threshold impairment is assumed to be a C/I = 18 dB. Maximum cell radius is set to R = 7 km and channel bandwidth is set to 5 MHz.

All victim links are assumed to employ distance proportional ATPC. At 3.5 GHz consideration of only a single cell-edge victim link was required [1]. However, to properly estimate the impact of rain attenuation at 10.5 GHz, a number victim links at random distances must be considered. This is the procedure employed in the following.

## 2.0 Simulation Results and Discussion

### 2.1 Clear Sky

Figures 1 and 2 illustrate simulation results under clear sky conditions. Figure 1 examines CS separation distances S from 0.1 to 2 km while Figure 2 examines distances from 3 to 6 km. They assume a 1'st adjacent carrier flanking and same polarization operation. Hence, the interference protection ratio (IPR) is just that of NFD and is assumed to be 27 dB. Primarily due to relative differences in link parameters, the results are approximately 8 dB improved over the 3.5 GHz simulations reported in [1]. However, they are still far from satisfactory and additional interference mitigation techniques are required.

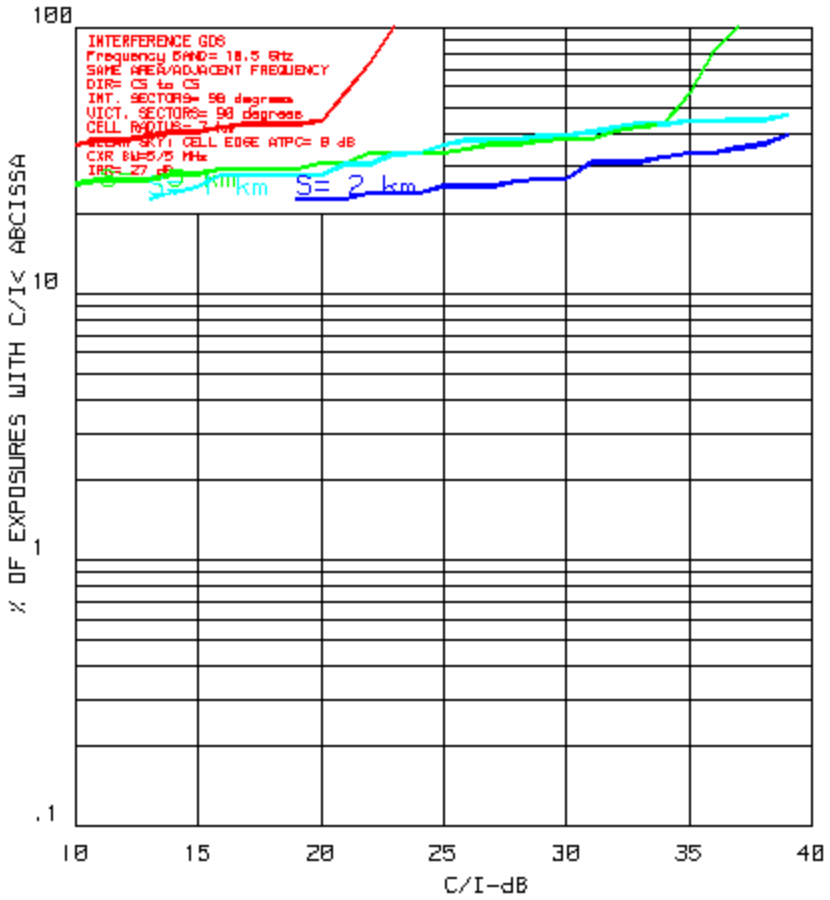


Figure 1. Clear Sky CDF for IPR =27 dB (S < 2 km)

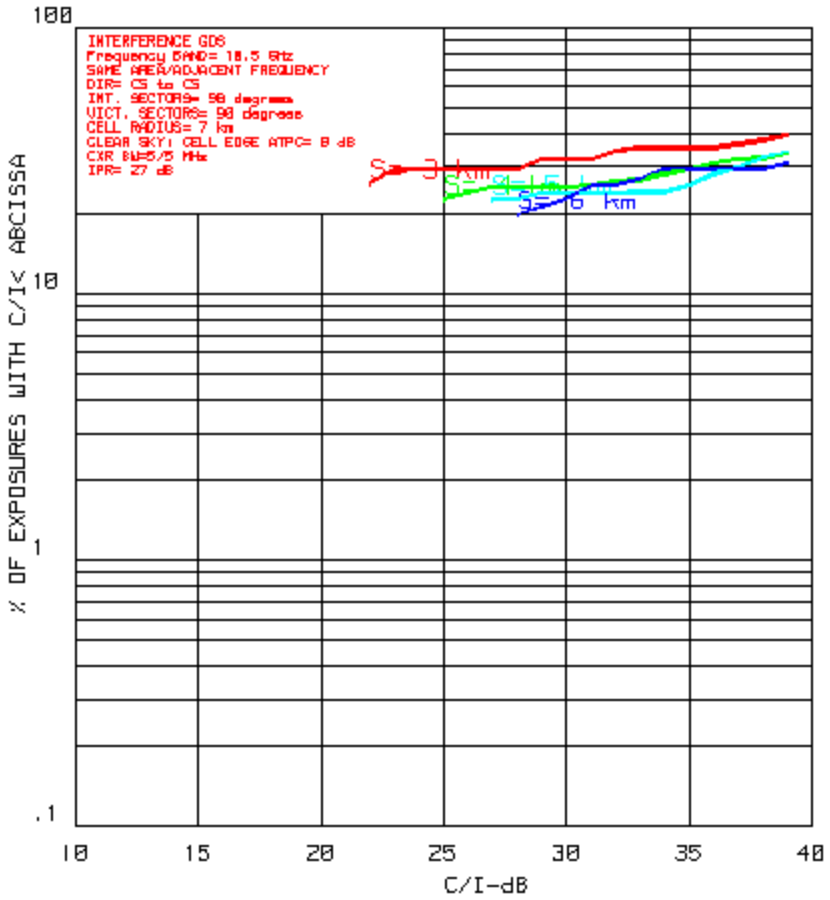


Figure 2. Clear Sky CDF for IPR =27 dB (S > 3 km)

Figure 3 illustrates a simulation when IPR is assumed to be improved to 49 dB. This can be achieved by operator coordination (cross-polarized operation), or, by the imposition of a guard band. At this point, only operation CS separation distances S less than 100 m remain problematic.

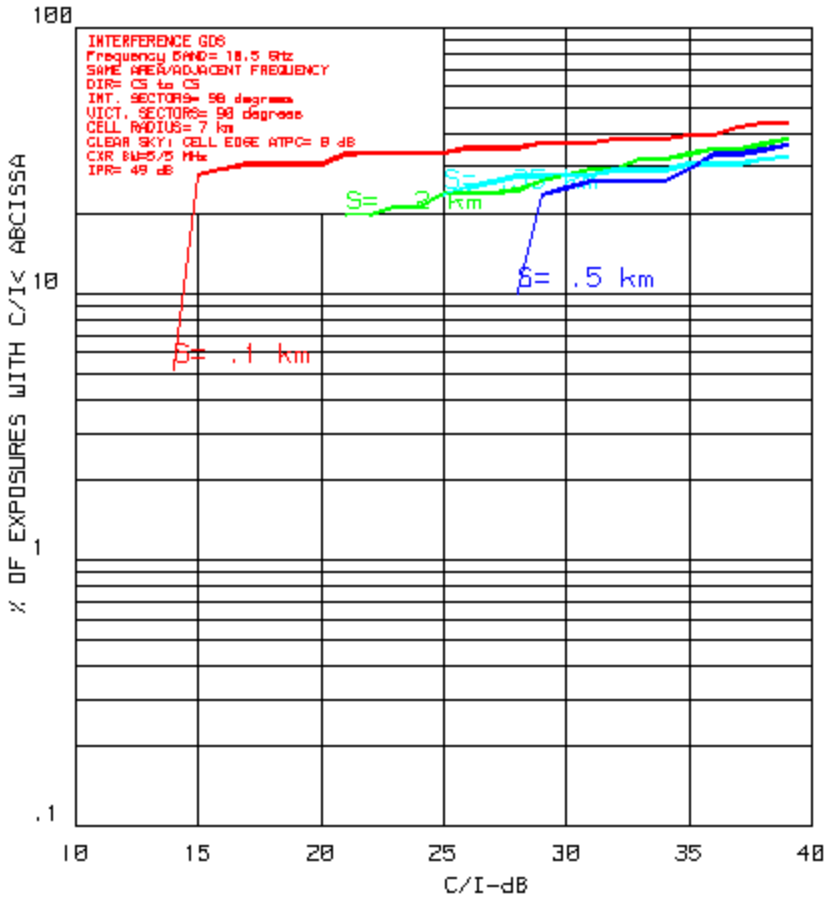


Figure 3. Clear Sky CDF for IPR =49 dB (S < 0.5 km)

## 2.2 Rain Faded

Figure 4 illustrates a simulation example for ITU-R rain region K. As the interference problem is most severe for small S, only distances less than 0.5 km are examined. When compared against the clear sky results of Figure 3, C/I performance is significantly degraded. However, the results are somewhat misleading. From link budget estimates, there is a clear sky fade margin of 16 dB. But, in [2], it is noted that only a rain fade margin requirement of 7 dB is necessary for a 7 km link availability of 99.99%. Ignoring atmospheric multipath, this

places rain faded C/N at 12 + 9 = 21 dB. C/I to exceed joint C/(N+I) performance threshold of 12 dB is thus 12.6 dB. Hence, one may conclude that S = 0.2 km would again represent a safe separation distance.

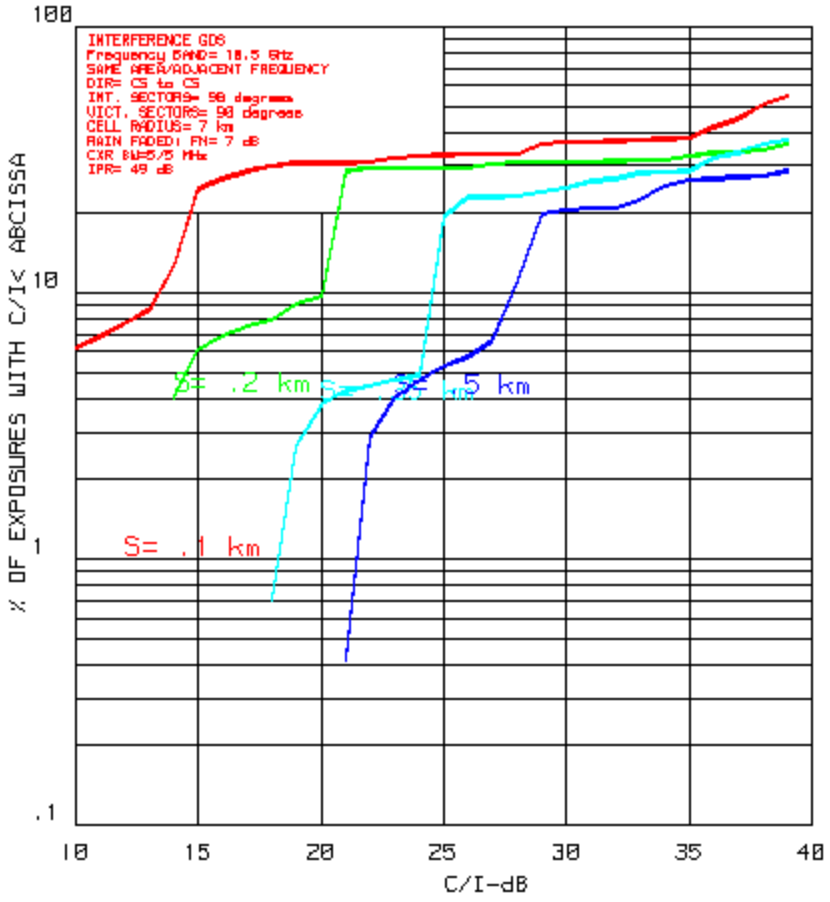


Figure 4. ITU-R Rain Region K CDF for IPR =49 dB (S < 0.5 km)

Figure 5 illustrates a simulation for an NFD of 49 dB in ITU-R rain region P.This is a most severe rain region that applies to tropical or sub-tropical locations. For this region, the requirement for 99.99 link availability is 16 dB. This equates to the margin available. Consequently, a 1 dB threshold impairment is at a C/I = 18 dB. From Figure 5, there are an unduly high percentage of interference vectors that would exceed this C/I limit. As well, there are also a large percentage of interference vectors that would exceed a performance threshold of 12 dB. Unless improved NFD is available, or multiple mitigation techniques are implemented, an achievement of 99.99% link availability is unlikely.

Now, if we could accept a link availability of 99.9%, the rain margin requirement reduces to 8 dB. Hence, the simulation results shown on Figure 4 approximate to the system simulation model. For this reduced availability objective, the previous discussion would apply and a CS separation distance of S = 200 m would be adequate with an NFD of 49 dB.

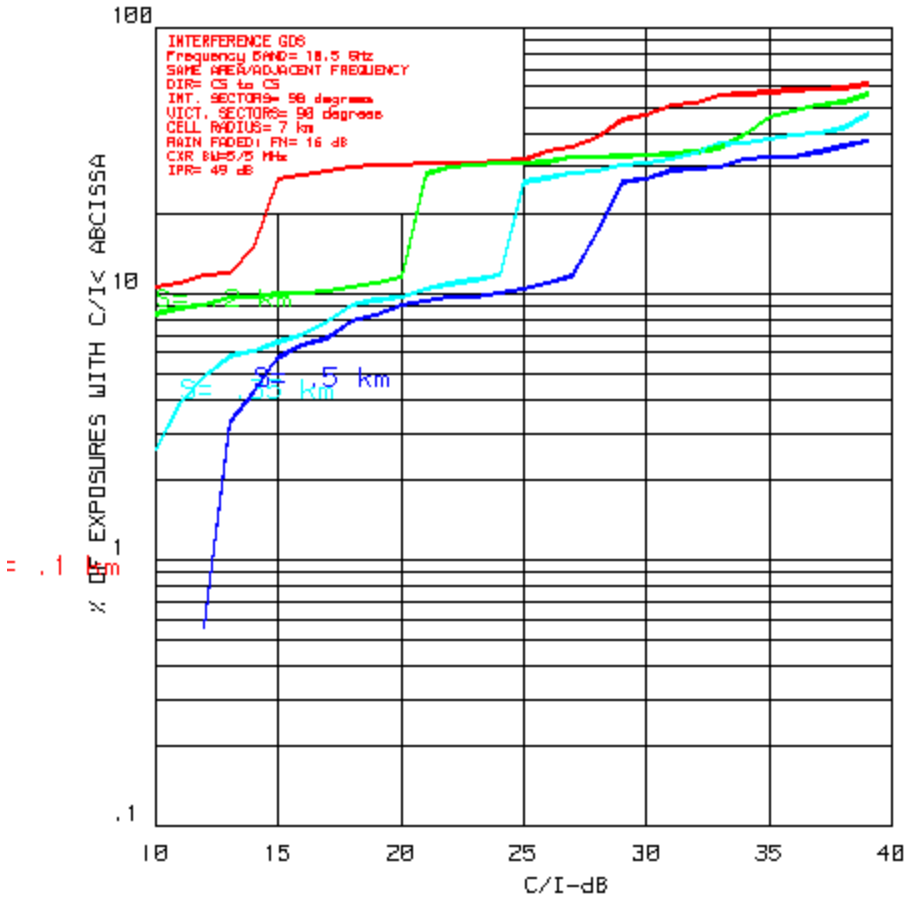


Figure 5. ITU-R Rain Region P CDF for IPR =49 dB (S < 0.5 km)

## 3.0 References

[1] Coexistence Same Area C/I Simulation Estimates at 3.5 GHz (CS to CS), C802.16.2a-02/09.

[2] A Simplified Method for the Estimation of Rain Attenuation at 10.5 GHz, C802.16.2a-02/15.

[3] An Addendum to: A Simplified Method for the Estimation of Rain Attenuation at 10.5 GHz, C802.16.2a- 02/17.

[4] Coexistence Co-Channel Boundary pfd Simulations at 10.5 GHz (Inbound), C802.16.2a-02/02r1.