Project	**IEEE 802.16 Broadband Wireless Access Working Group**
Title	**Outbound Boundary pfd Simulations at 3.5 GHz**
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Re:	Coexistence pfd Simulation Estimates in Support of 802.16a System Design
Abstract	This document examines outbound pfd requirements at 3.5 GHz. It identifies the distance limits for which coordination may be required between system operators. The conclusions are specific to the system model selected. Other system model parameters may modify the distance coordination requirements.
Purpose	This document is provided for consideration and inclusion in the amended Coexistence Practice Document for PMP systems operating below 11 GHz (P802.16.2a).
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Outbound Boundary pfd Simulations at 3.5 GHz

1.0 Introduction

In a companion contribution [1], pfd estimates were developed for inbound interference estimates as a function of separation distance D. In that case, both the interference and victim links were assumed to be operating at a 16-QAM modulation index. For this analysis the outbound victim link is now assumed to be 64-QAM, and the interference link is also assumed to be 64 QAM.

For the outbound case all that is required is to reverse the direction of transmission by adjusting the TX power and antenna gain to be that of an interference CS. All of the equipment and transmission parameters remain as in [1]. LOS transmission is again assumed for a maximum cell radius of R = 7 km. Excess path loss exponents are assumed to be LOS for the full length of the interference path or LOS to 7 km and d^{-4} beyond.

2.0 Simulation Transmission Parameters and Limiting pfd Considerations

Typical system and equipment parameters are given in Table 1. These conform to those given in Section 3.0 of [1] but are specific to 64-QAM transmission.

Propagation Models:	as per section 1
Atmospheric Multipath Model:	Vigants-Barnett (annual - 2 way)
Maximum Cell Radius:	7 km
Channel Bandwidth:	7 MHz
Nyquist Bandwidth:	5.6 MHz
TS TX Power:	+21 dBm
CS TX Power:	+29.5 dBm
TS Antenna Gain:	+18 dBi
CS Antenna Gain:	+14.5 dBi
Receiver Noise Figure:	5 dB
TX/RX RF Losses:	3 dB at each end
Link Availability:	99.99% @ BER=10^{-6}
Modulation Index:	64 QAM
Receiver C/N Threshold:	24 dB

Table 1. Transmission Parameters

Limiting pfd values change in accordance with the modulation threshold requirements and the transmission parameters selected. Those appropriate to this study are summarized in Table 2.

Parameter	Value
$(C/N)_{threshold}$ 64-QAM	24 dB

pfd_sig_threshold	-98.6 dBW/m^2/MHz
effective pfd_noise	-122.6 dB/m^2/MHz
$(C/I)_{1\ \text{dB threshold impairment}}$ (I/N=-6 dB)	30 dB
pfd_int_1dB (I/N=-6 dB)	-128.6 dBW/m^2/MHz

Table 2. C/N, C/I and pfd Relationships.

3.0 Simulation Model and Methodology

Figure 1 illustrates the simulation model. As for previous simulations, both interference and victim sectors are independently spun in 5 degree increments. For each spin, the most severe interference level is selected from 20 randomly located TS locations and entered into a database. A simulation run thus consists of 72↔72 = 5184 pfd estimates that are sorted and presented as a CDF as a function of separation distance D.

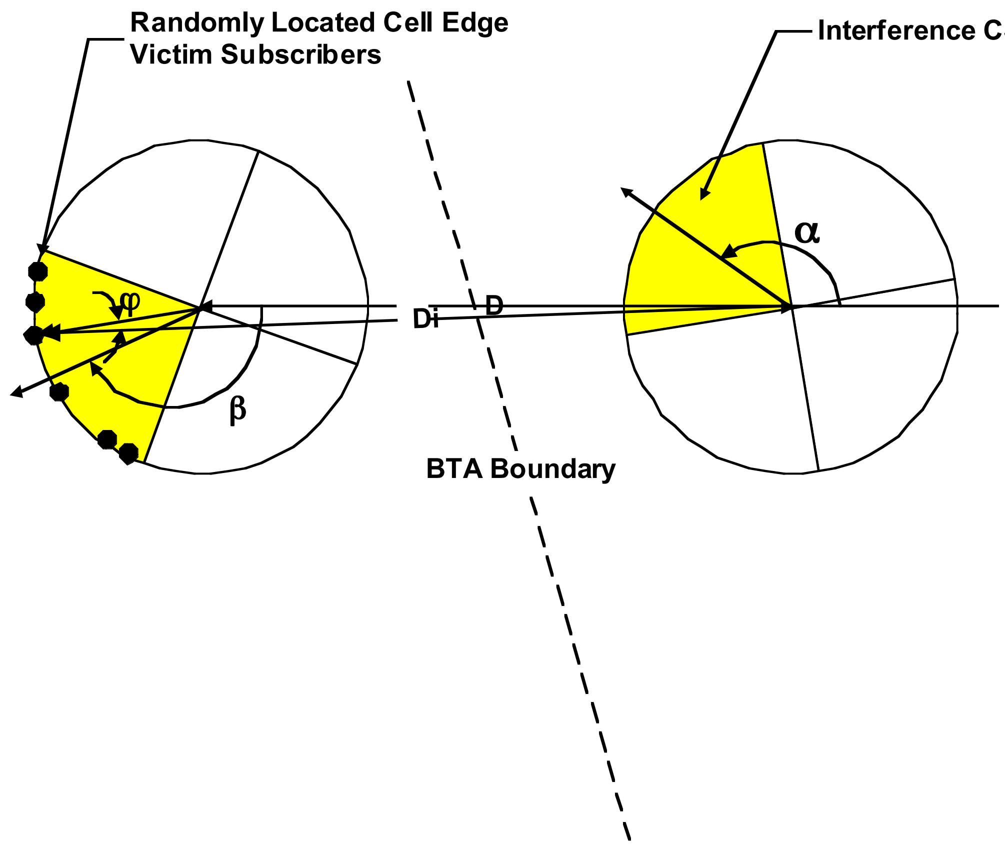

Figure 1. Simulation Model

4.0 Simulation Results

Figure 2 illustrates the CDF simulation estimates assuming that all interference paths are LOS. As compared to the inbound pfd estimates, of [1]- Figure 3, the pfd levels have moved 5 dB to the left. This is the result of the 5 dB increase in EIRP of the TX Power/Antenna Gain differences referenced to the transmission parameters. However, the difference between inbound/outbound RX gain modifies the pfd value for I/N = - 6 dB to -128.6 dBW/m^2/MHz. At this level, approximately 15 % to 20 % of the exposures are in this range, up to the horizon distance of D between 60 - 80 km.

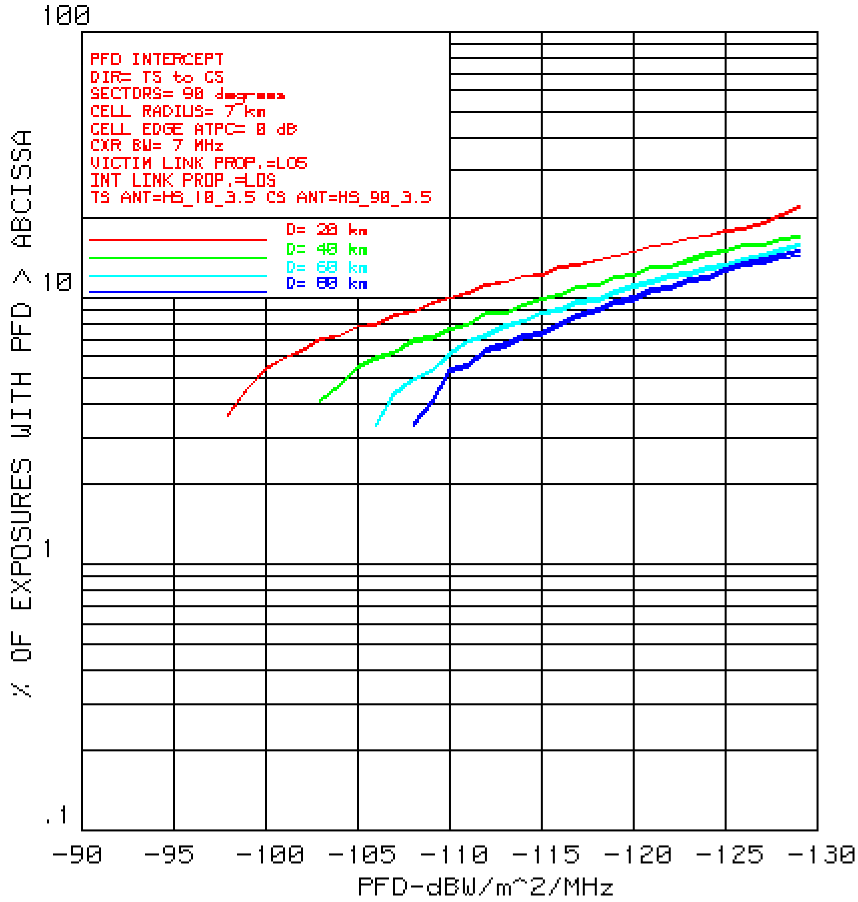

Figure 2. CDF Simulation Estimates for LOS Interference Vectors

Figure 3 illustrates the simulation results when an excess path loss corresponding to d^{-4} is assumed for all interference links greater than 7 km. As expected, the % of exposures that exceed - 128.6 dBW/m^2/MHz are significantly reduced as a function of separation distance D. At a first assumed horizon distance of D = 60 km, there still exists a 5% probability of conflict to an I/N = -6 dB. At D = 80 km, there are no interference conflicts up to the I/N objective.

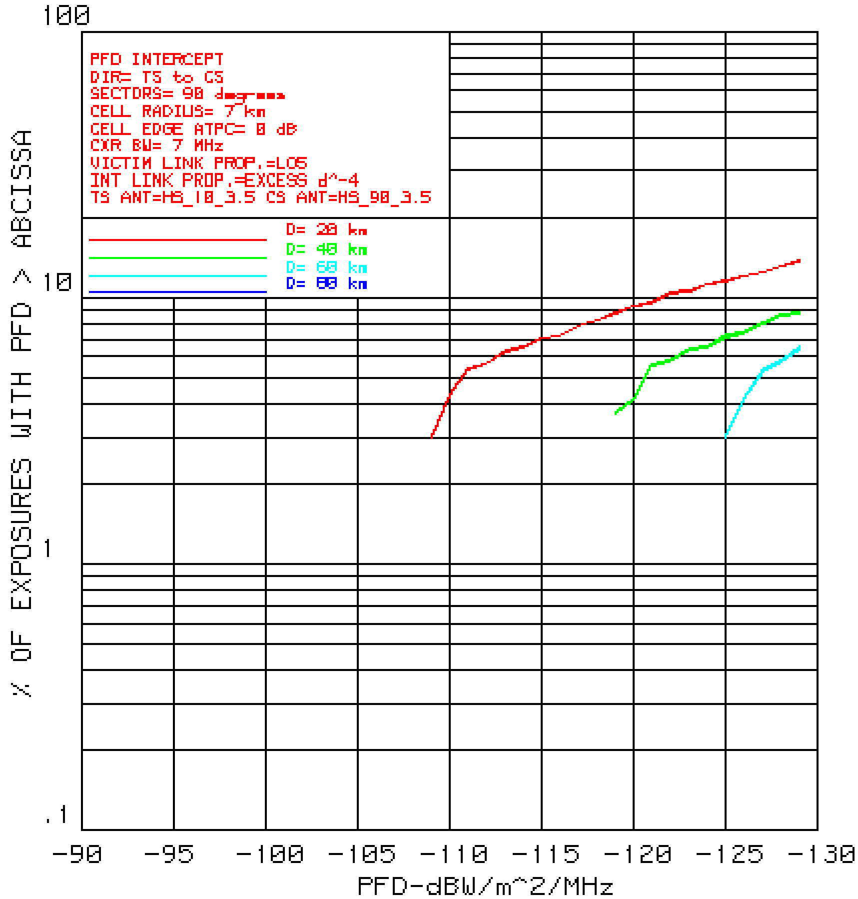

Figure 3. CDF Simulation Estimates for Interference Vectors with Excess Path Loss

From the foregoing, it may be concluded that boundary co-channel CS to TS interference conflicts cannot be acceptably constrained unless there is operator coordination of sector alignments. This would apply up to an assumed horizon distance of somewhere between 60 - 80 km.

5.0 References

[1] Coexistence Co-Channel Boundary pfd Simulations at 3.5 GHz (Inbound). Revision 1 (IEEE C802.16.2a-02/02r1)