Project	**IEEE 802.16 Broadband Wireless Access Working Group**		
Title	**Requirement on Receiver Linearity**		
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Source	Reza Arefi WFI 1840 Michael Faraday Dr. Suite 200 Reston, VA 20190	Voice: Fax: E-mail:	(703) 375-7703 (703) 904-7455 reza.arefi@wfinet.com
Re:	Call for contributions on receiver linearity requirements for Broadband Wireless Access systems, meeting #3, Boulder, Colorado, September 17, 1999.		
Abstract	This document recommends general requirement on the linearity of the receiver of a BWA system.		
Purpose	It is proposed that 802.16.2 (Coexistence Task Group) adopt the guidelines recommended in this document as the receiver linearity requirements within the Recommended Practices Document.		
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Requirement on Receiver Linearity

Reza Arefi
Wireless Facilities, Inc. (WFI)

Introduction

The linearity of a broadband receiver plays an important role in the overall performance of the system. It affects major operational, systems level parameters such as receiver sensitivity and link budget. The linearity of the receiver is best summarized in the concept of *Equivalent Input Intercept Point* of the receiver [1]. This parameter takes into consideration the effect of non-linearity of every stage in the receiver, including amplifiers, mixers, and filters. This process assumes that the distortion products of the various stages are uncorrelated and, therefore, their power could be added linearly. Also, it is assumed here that 2nd and 3rd order intercept points have the most effect on the linearity of the receiver but the results can be applied to nth order harmonics as well.

Equivalent 2nd Order Input Intercept Point

The 2nd intercept point, IP_2, predicts the performance of mixers with respect to a certain spurious response called half-IF (1/2 IF). This spurious response is generated by $2f_{RF} \pm 2f_{LO}$. The level of this spurious response is related to IP_2 of mixer, total on-channel gain of all the stages between antenna and mixer, and selectivity of those stages at _ IF frequency. As a preliminary recommendation, it is proposed that the IP_2 of mixer and, therefore, the total equivalent IP_2 of the receiver be at a level that _ IF rejection of at least **100 dB** is achieved.

Equivalent 3rd Order Input Intercept Point

The 3rd intercept point is another measure of system linearity. Once the total equivalent input third order intercept point is calculated based on the formula described in [1], the power of the 3rd order intermodulation harmonic can be calculated from the following formula.

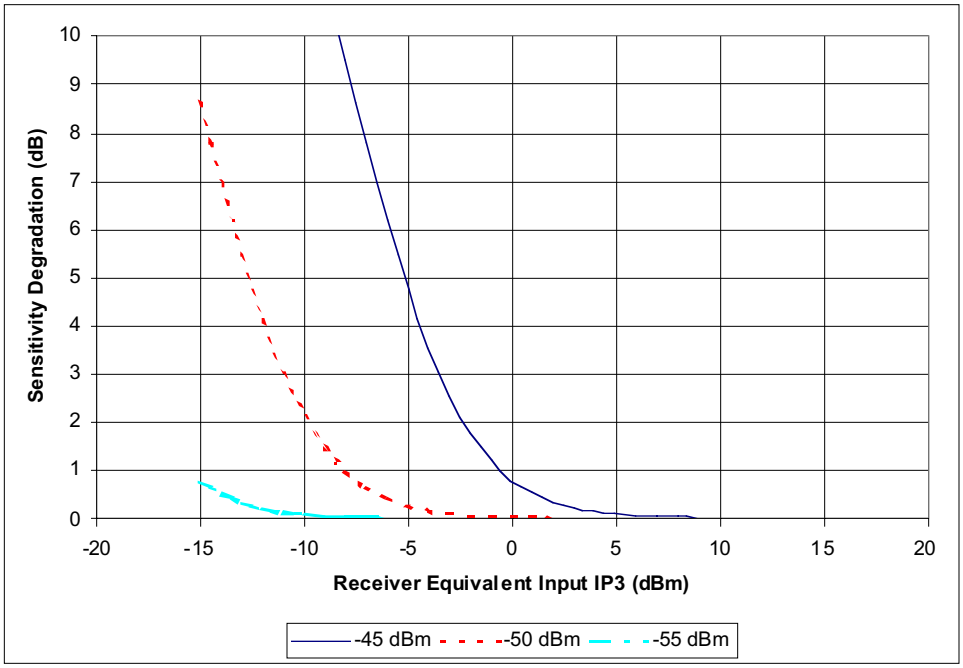
$$IP_3 = A + \frac{A - P_{IM}}{2}$$

$$A = \text{input level}\,(\text{dBm})$$

If the intermodulation power is the only factor contributing to the degradation of receiver sensitivity [2], then the amount of this degradation is related to intermodulation power by the following formula.

$$\Delta S = 1 + \frac{P_{IM}}{kTBF} \quad \text{(linear)}$$

The following graph shows the amount of degradation versus IP_3 for three input levels of –45, -50, and –55 dBm. Other assumptions: B=10 MHz, F=6 dB, T=290°K.



By setting the maximum allowable degradation in receiver sensitivity to δ dB, the minimum equivalent input IP_3 can be calculated as follows.

$$\Delta S \le 10^{0.1\delta}$$

$$P_{IM} \le kTBF(10^{0.1\delta} - 1)$$

$$IP_3 \ ? \ A + \frac{A - 10\log(kTBF(10^{0.1\delta} - 1))}{2} \ dBm$$

It is recommended that IEEE 802.16 adopt the above criteria for equivalent input IP_2 and IP_3 as the guideline for receiver linearity.

References

[1] Arefi, R., "*Degradation Limit on Receiver Sensitivity*", Submission to IEEE 802.16, Meeting #4, IEEE 802.16cc-99/30.

[2] Arefi, R., Etemad, K., *"Effect of Intermodulation Noise and Distortion on Performance of Broadband Radios",* Proceedings, 6th Annual WCA Technical Symposium, November 15-16, 1999, Dallas, To be published.