Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** <**http://grouper.ieee.org/groups/802/20/**>
Title	**Proposed Text for Evaluation Criteria Document – RF Performance Issues**
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Re:	MBWA Call for Contributions: Session # 9 - July 12-16, 2004
Abstract	This document provides proposed text on RF performance issues for incorporation in the 802.20 Evaluation Criteria Document.
Purpose	Address essential RF performance parameters in the EC models.
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1.0 Purpose

This contribution proposes a baseline text for the IEEE 802.20 Evaluation Criteria document. It proposes values and usage scope for key RF performance parameters that are deemed necessary for establishing a uniform RF transmission model that all proposals would adopt for the evaluation criteria simulations.

The following proposed text builds on previous discussions and contributions [1] and [2] and is recommended for incorporation in section 10 of the Evaluation Criteria document v10 [3].

2.0 Proposed Text for the Evaluation Criteria Document

Draft 802.20 Permanent Document

<802.20 Evaluation Criteria – Ver 10>

10. RF Environment

10.1 Radio Transceiver Characteristics

The RF environment for the EC model shall be defined by a set of RF parameters that should be considered as fixed constrains leaving open only technology-specific performance attributes that proposals are expected to exhibit.

Table 10-1 defines the transmitter and receiver parameters for the base station (BS) and the mobile station (MS). Note that some parameters vary with channel bandwidth. Base values were chosen for a 5 MHz channel and adjustments were made for 1.25 MHz and 10 MHz channels. The adjustment for other channel bandwidths can easily be calculated by factoring the channel BW ratio to the 5 MHz channel.

The maximum base station (BS) **transmit power** is specified here as peak power density per 1 MHz of channel bandwidth and is +43 dBm. The mobile station (MS) maximum transmit power shall be +27 dBm for all channel bandwidths.

The **out-of-band emission** limits were chosen to be those specified by the FCC for the PCS band. Note that this requirement shall apply to both band/block edge channels and

middle channels. Thus, the shape of the emission mask is not material to the evaluation criteria and need not be submitted. Instead, the **occupied bandwidth** (OB) of a single transmit channel (characterized by a carrier frequency or a center frequency in the case of OFDM modulation) shall adhere to the definition of OB provided in the SRD, namely, "the OB shall contain 99% of the transmit power". It shall be further required, for the evaluation criteria purposes, that **no guard bands** would be allowed in the evaluated spectrum block, other than that contained within an individual channel, i.e., included in the occupied bandwidth.

Thus, adopting the **FCC emission attenuation formula** (Table 10-1, item 3), the maximum out-of-band power shall be -13dBm for all transmit powers and all channel bandwidths. The resolution bandwidth for "measurement" of out-of-band emissions shall be 1 MHz.

To achieve a fair performance comparison of different technologies, the receiver characteristics should also be set uniformly and thus define a common interference environment. Hence, it is required that the receiver **noise figure (NF)** be specified uniformly and shall be: 10 dB for the MS and 5 dB for the BS for all technologies and channel bandwidths.

The theoretical **receiver sensitivity** level should vary by technology, but it is required that it be specified for raw data bit error rate of 0.1%.

The following parameters determine the interference environment for a single channel: **ACLR, Selectivity and Blocking**. Thus, the total interference power present in the channel should consist of the aggregate co-channel interference and adjacent and second-adjacent channel interferences. The interference contribution of the adjacent channels (x2) and blocking signals (x2) shall be calculated by applying the ACLR and selectivity figures from table 10-1 or from the technical specifications of a given proposal. Note that the values of ACLR and Selectivity in table 10-1 are **recommended** values. Proposals may offer different specifications (for ACLR and selectivity), in which case, they must commit their entire performance analysis to these specifications.

Contribution # C802.20-04-58 [2] proposes an alternative method (to ACLR) to analyze the impact on performance of adjacent channel interference. Proposal may choose to use either method.

Table 1: Evaluation Criteria RF Parameters

#	RF Parameter	Base Value	1.25 MH Ch BW	5 MHz Ch BW	10 MHz Ch BW
1	Transmitter Power -- **BS**	43 dBm/MHz	+44 dBm	+50 dBm	+53 dBm
2	Transmitter Power -- **MS**	27 dBm	+27 dBm	+27 dBm	+27 dBm

3	Out of Band emission limits – BS and MS (emission measured in 1 MHz resolution bandwidth)	Attenuation of the transmit power P by: 43 +10 log(P) dB	-13 dBm	-13 dBm	-13 dBm
4*	ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) -- **BS**	45 dB	39 dB	45 dB	48 dB
5*	ACLR - Attenuation of emissions into an adjacent channel (same Ch BW) -- **MS**	33 dB	27 dB	33 dB	36 dB
6	Receiver noise figure -- **BS**	5 dB	5 dB	5 dB	5 dB
7	Receiver noise figure -- **MS**	10 dB	10 dB	10 dB	10 dB
8	Receiver reference sensitivity (to be proposed by each technology)	Specify at BER of 0.1%	*value 1 (proposal specific)*	*value 2 (proposal specific)*	*value 3 (proposal specific)*
9*	Receiver Selectivity -- **BS**	63 dB	63 dB	63 dB	63 dB
10*	Receiver Selectivity -- **MS**	33 dB	33 dB	33 dB	33 dB
11	Receiver Blocking – **BS** (level of same technology blocking signal at frequency offset of 2*Channel BW)	-40 dBm	-40 dBm	-40 dBm	-40 dBm
12	Receiver Blocking – **MS** (level of same technology blocking signal at frequency offset of 2*Channel BW)	-56 dBm	-56 dBm	-56 dBm	-56 dBm

* Recommended values. Proposals may choose (and commit to) different values.

10.2 Link Budget

[Open items: Should maximum range (link budget) be used as a performance metric for proposal comparison or not? Also need to determine how to use the building/vehicular penetration loss numbers for different environments]

Table 10-2: Link Budget Template 1

id/ ii	Item	Downlink	Uplink
	Test environment	Suburban/urban macro-cell, micro-cell, indoor pico-cell	Suburban/urban macro-cell, micro-cell, indoor pico-cell
	Operating frequency	1.9GHz	1.9GHz
	Test service		
	Multipath channel class	Cases I-V	Cases I-V
ii/id	(a0) Average transmitter power per traffic channel (NOTE 1)	dBm	dBm
id	(a1) Maximum transmitter power per traffic channel	dBm	dBm
id	(a2) Maximum total transmitter power	43 dBm/MHz	27dBm
ii	(b) Cable, connector, and combiner losses (enumerate sources)	3 dB	0 dB
	Body Losses	0 dB	3 dB
ii	(c) Transmitter antenna gain	17 dBi	0 dBi
id	(d1) **Transmitter e.i.r.p. per traffic channel = (a1 – b + c)**	dBm	dBm
id	(d2) **Total transmitter e.i.r.p. = (a2 – b + c)**	57 dBm	27 dBm
	Penetration Loss (Ref: 3GPP2) [Determine how to use these numbers for different environments, revisit if 20dB is a reasonable value for building penetration)]	20 dB (Building) 10 dB (Vehicular)	20 dB (Building) 10 dB (Vehicular)
ii	(e) Receiver antenna gain	0 dBi	17 dBi
ii	(f) Cable and connector losses	0 dB	3 dB
	Body Losses	3 dB	0 dB
ii	(g) Receiver noise figure	10 dB	5 dB
ii	(h) Thermal noise density (H) (linear units)	–174 dBm/Hz 3.98×10^{-18} mW/Hz	–174 dBm/Hz 3.98×10^{-18} mW/Hz
id	(i) Receiver interference density (NOTE 2) (I) (linear units)	dBm/Hz mW/Hz	dBm/Hz mW/Hz
id	(j) **Total effective noise plus interference density = 10 log ($10^{((g + h)/10)}$ + I)**	dBm/Hz	dBm/Hz
ii	(k) Information rate (10 log (R_b))	dB(Hz)	dB(Hz)

id	(l) Required $E_b/(N_0 + I_0)$	dB	dB
id	(m) **Receiver sensitivity = (j + k + l)**		
id	(n) Hand-off gain	dB	dB
id	(o) Explicit diversity gain	dB	dB
id	(o′) Other gain	dB	dB
id	(p) Log-normal fade margin	dB	dB
id	(q) **Maximum path loss = {d1 – m + (e – f) + o + n + o′ – p}**	dB	dB
id	(r) Maximum range	m	m

3.0 References

1. IEEE 802.20, contribution # C802.20-04-51r2 (MS PowerPoint presentation): **RF Performance Evaluation Criteria**

2. IEEE 802.20, contribution # C802.20-04-58: **Evaluation of 802.20 proposals with adjacent channel interference considerations.**

3. IEEE 802.20 Evaluation Criteria document version 10, July 2004