Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Input on Evaluation Methodology and Key Criteria for P802.16m
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Re:	Call For Contributions on Evaluation Methodology and Key Criteria for P802.16m – Advanced Air Interface (IEEE 802.16m-07/005r2).
Abstract	This contribution provides input on Evaluation Methodology and System Simulation Criteria to be used in evaluation of the P802.16m Advanced Air Interface amendment.
Purpose	This document is submitted in response to the Call For Contributions on Evaluation Methodology and Key Criteria for P802.16m – Advanced Air Interface, dated 2007-01-18, issued by the 802.16 Working Group.
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be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Input on System Evaluation Methodology

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1. Introduction

This contribution provides input on system evaluation methodology and system simulation criteria to be used in evaluation of the P802.16m advanced air interface amendment. It intends to capture the key requirements, criteria and simulation and evaluation methodology for multiple antenna systems, including beamforming/AAS, MIMO and hybrid MIMO/beamforming systems.

2. Channel Model Requirements

Channel model requirements are specified in Table 1. Use of the Geometrically Based Elliptical Model (GBEM) is proposed to simulate a multi-antenna system in both fixed and mobile environments. Published simulation and measurement results (see references) show that GBEM is a good fit for multi-antenna systems.

The table below captures an example set of channel model parameters.

Table 1. Channel Model Parameters

Parameter setup	Values
Path loss models	Hata Cost 231, Erceg A, B, C, WI
Log normal shadowing standard deviation (dB)	8~10
BS to BS shadowing correlation	0.5
Building penetration loss (dB)	15
Vertical vs. horizontal polarization correction factors	TBD
Multiple scattering reflectors with variable delays in time	3, 4, 5, 6
Multipath models	SUI, ITU-PB, VA, SCM and GBEM*
Mobile Speed (km/h)	Up to 120

* Geometrically Based single bounce Elliptical Model

The basic mobile multipath environment is shown in Figure 1. GBEM characterizes the excess delay, angle of arrival (AOA) and the received power of the multipaths. It is used to characterize AOA of the received components at MS when most significant scatters are near the MS, as may be the case in macro cell in which the BS antenna is much higher than the surrounding terrain. In urban micro cell, the BS antenna is relatively low, the geometry does not support the notion that all significant scatters are clustered about one end of the link. In this case, GBEM provides a more reasonable approximation: short delay multipath components are more likely to arrive with AOA near direct path and multipath components with longer delays are more uniformly distributed in AOA.

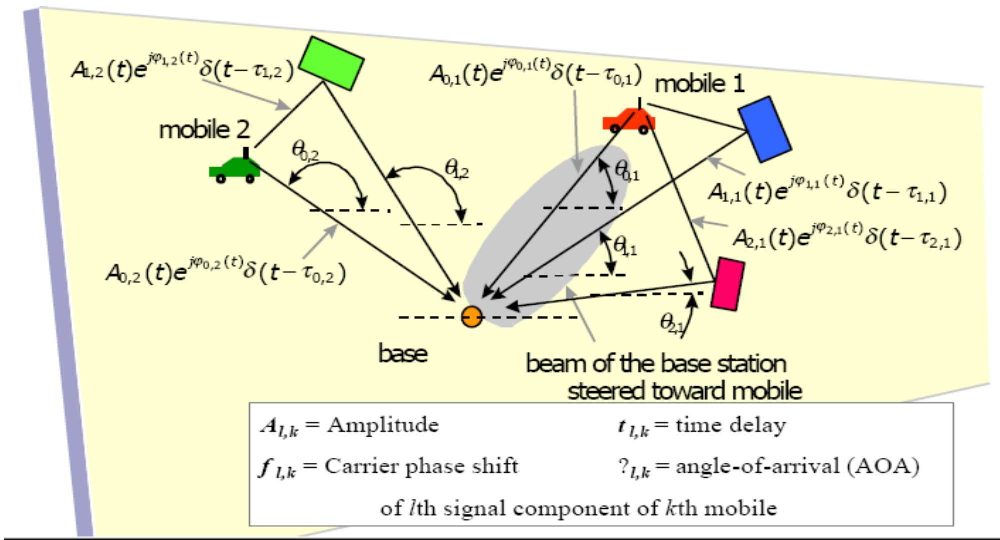

Figure 1. The Mobile Multipath Environment

Sources: J. C. Liberti and T. S. Rappaport, “Smart Antennas for CDMA Wireless Systems”. Application to IS-95 and WCDMA, Prentice Hall, Prentic Hall, NJ, 1998.

The GBEM channel impulse response is as follows:

$$h_b(t,\tau_k,\phi_k) = \sum_k \alpha(\phi_k) e^{j\theta_k} p(t-\tau_k)$$

Where:

$\alpha^2(\phi_k)$ = power of kth multipath component

τ_k = relative time delay of kth multipath component

θ_k = phase of kth multipath component

$p(t)$ = narrow pulse approximating delta function

ϕ_k = angle-of-arrival of kth multipath component

3. System Simulation Inputs and Criteria

Simulations to be developed and undertaken for the purpose of evaluating system and technical proposals for P802.16m should incorporate the requirements and criteria identified in this section.

3.1 System Simulation Requirements

The parameters in Table 2 are used to setup the system level simulation. Typical parameter values are provided but are subject to changed based on the system definition chosen for 802.16m.

Hexagonal layout cell configuration should be used and the radius of cell specified. The antenna patterns can be specified from 30° to 120° of 3dB beam width for supporting multi sectorization patterns. Multiple antenna systems consisting of up to 18 antennas are suggested at the BS in order to meet the P802.16m advanced performance requirements.

Table 2. System Level Simulation Requirements

Parameter setup	Typical Value Range
Number of cells	19
Number of sectors per cell	1, 3, 4 and 6
Cell size (km)	Up to 30
BS antenna pattern	$30^{o} \sim 120^{o}$ (-3dB) with 20 dB front to back ratio
MS antenna pattern	$30^{o} \sim 120^{o}$ (-3dB) with 20 dB front to back ratio
Number of antennas at BS	Up to 18
Number of antennas at MS	Up to 2
Antenna type	Polarization
BS antenna height (m)	Up to 50
MS antenna height (m)	Up to 2
BS antenna gain (dB)	Up to 18
MS antenna gain (dB)	Up to 8
BS noise figure (dB)	Up to 5
MS noise figure (dB)	Up to 10
BS array space (wavelength)	Up to 21.5
MS array space (wavelength)	Up to 1.0
Maximum Tx power at BS (dBm)	30~50
Maximum Tx power at MS (dBm)	23 (200mW)

3.2 Radio Link Setup Requirements

A recommended set of link level simulation parameters are provided below:

Center frequency (MHz)

Channel bandwidths (MHz)

FFT sizes

Frame length (ms)

DL/UL ratio

Modulation

Coding scheme

Permutation

Channel estimation

HARQ

AMCS thresholds

Power control

Array processing setup (MIMO, AAS)

3.4 Interference

Interference from all MS should be computed to each BS.

Interference from all base stations should be computed to each MS.

3.5 Simulation Outputs

The simulation outputs should include CDF of input SINR and output SINR for each link, CDF of aggregate Tx power for DL and UL at BS and MS, which means the distribution of Tx power allocation for the different beamforming, aggregate capacity (spectral efficiency) of BS at outage % and the link throughput which includes user throughput and cell/sector throughput.

Table 3. Simulation Outputs

Outputs	Comments
CDF of Input SINR and output SINR for each link	
CDF of Aggregate Tx power for DL and UL at BS and MS	
Aggregate capacity of BS at outage (Spectral efficiency)	bps/Hz
User throughput and cell/sector throughput	Bps/ user, bps/cell or sector

4. References

[1] Joseph C. Liberti, Theodore S. Rappaport" A Geometrically Based Model for Line-Of-Sight Multipath Radio Channels". Vehicular Technology Conference, 1996, Mobile Technology for the Human Race, IEEE 46th, April, 1996.

[2] M. C. Bromberg, "Optimizing MIMO multipoint wireless network assuming Gaussian other-user interference", IEEE Transaction on Information Theory, 49 (10) Oct. 2003.

[3] Theodore S. Rappaport," Wireless Channel Models and Simulators from Real-Word Data", 8th IEEE CDMAD International Workshop, June, 2002

[4] J. C. Liberti and T. S. Rappaport, "Smart Antennas for CDMA Wireless Systems". Application to IS-95 and WCDMA, Prentic Hall, Prentic Hall, NJ, 1998.