Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Recommended IEEE 802.16m Requirements Text for Section 7.0**
Date Submitted	**2007-02-23**
Source(s)	Mark Cudak, Kevin Baum, Marc De Courville, Scott Migaldi mark.cudak@motorola.com Motorola – CTO Office Ken Stewart, Floyd Simpson Jeff Zhuang Motorola – Mobile Devices Amitava Ghosh, Stavros Tzavidas Fan Wang, Hua Xu Motorola – Networks & Enterprise Hokyu Choi, Taeyoung Kim, Jaeweon Cho, DS Park choihk@samsung.com Samsung
Re:	Response to call for contributions on requirements for P802.16m – Advanced Air Interface
Abstract	This document proposes text for Section 7.0
Purpose	For consideration of 802.16 TGm Requirements drafting group
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might 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>.

Contents

7.0Performance requirements

The performance goal is specified in terms of spectral efficiency performance relative to 802.16e (WiMAX Release-1) baseline system using 2 transmit and 2 receive antennas at the base station and 1 transmit and 2 receive antennas at the mobile station. The performance metrics are average sector throughput, average user throughput and five percentile user throughput (cell edge throughput) defined in Table 1. The performance goals are specified separately for a data only and Voice over IP (VoIP) only system respectively.

Table 1. Performance metrics

Metric	Definitions
Sector throughput	$\frac{\text{good bits in [0,T]}}{T}$
User packet call throughput	$\frac{1}{K}\sum_{k=1}^{K}\frac{\text{bits in packet call k}}{(t_{end\_k}-t_{arrival\_k})}$
Cell edge user throughput	5% user throughput
Sector spectral efficiency (TDD)	$\frac{\text{Sector (DL/UL) Throughput}}{\text{Total Sector BW}\quad\%\text{(DL/UL) Split}}$
Sector spectral efficiency (FDD)	$\frac{\text{Sector (DL/UL) Throughput}}{\text{Sector (DL/UL) BW}}$

[Note: The performance metrics in Table 1 shall be superseded by the definition in the Evaluation Methodology document.]

7.1 User throughput

The targets for average user-throughput and ~~five percentile~~cell-edge user throughput of downlink/uplink for data only system for baseline antenna configuration is shown in Table 2. Both targets should be achieved assuming 802.16e reference performance as per antenna configuration defined above and using an MMSE receiver and assumptions in the WiMAX white paper[1].

Table 2. Data only system

Metric	DL Data (x 802.16e)	UL Data (x802.16e)
Average User Throughput	> 2x	>1.5x
Cell Edge ~~Five Percentile~~ User Throughput	> 2x	>1.5x

Note that the Cell Edge User Throughput is defined as the 5% point of the cumulative distribution function (CDF) of the user throughput for a given DL:UL ratio (in TDD duplex mode), a given number of users, site-to-site distance, and a given fairness and delay criterion in a fully loaded network with full-buffer traffic.

[1] http://www.wimaxforum.org/technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf

The reference VoIP system should support a 8 kbps codec with a 50% activity factor such that the percentage of users in outage is less than 5% where outage is defined such 98% of the VoIP packets are delivered successfully to the users within the delay bound of *x* msec.

7.2 Spectrum efficiency

802.16m should deliver significantly improved spectrum efficiency and increased cell edge bit rate while maintaining the same site locations as deployed for current 802.16e system. The targets for data and voice spectral efficiency for baseline antenna configuration over 802.16e (WiMAX Release-1) system is shown in Table 3.

Table 3. Data only system

Metric	DL (x 802.16e)	UL (x802.16e)
Data Spectral Efficiency (bps/Hz/sector)	> 2x	>1.5x
VoIP Spectral Efficiency (Erlangs/MHz/sector)	> 2.5x	>2.5x

7.3 Mobility

Mobility shall be supported across the 802.16m network. The 802.16m system should be optimized for low speed, and should support higher speeds with reasonable degradation. Table 4 summarizes the mobility performance.

Table 4. 802.16m mobility support

Mobility	Performance
Low (0 – 15 kmph)	Optimized
High (15 – 120 kmph)	Marginal degradation
Higher (up to 350 kmph)	System should be functional

It may be noted that speeds above 250 km/hr are applicable for special cases such as high speed trains. 802.16m shall also support techniques and mechanisms to optimize delay and packet loss during handover between 802.16m and other broadband wireless and cellular systems including the WiMAX Release-1 (IEEE 802.16e), WiFi, cdma-2000-1x, GSM etc..

High performance handover algorithms should be designed by taking into consideration all relevant system aspects and costs, such as over-the-air overhead and algorithmic security.

7.4 Coverage

The IEEE 802.16m shall significantly improve the coverage of the current WiMAX-Release1 (IEEE 802.16e) system. The link budget of the limiting link (e.g. DL MAP, UL Bearer) of 802.16e shall be improved by at least 3 dB compared to the WiMAX (IEEE 802.16e) using similar system configurations. Specifically, 802.16m shall support the following deployment scenarios in terms of maximum cell range:

Table 5. 802.16m Deployment Scenarios

Cell Range	**Performance target**

Up to 5 km	Optimized Performance targets defined in clause 7.1-7.3 should be met
5-30 km	Graceful degradation in system/edge spectral efficiency
30-100 km	System should be functional (noise limited scenario)

7.5 Enhanced Multicast-Broadcast

As outlined in Section 6, the 802.16m amendment shall provide support for enhanced Multicast Broadcast Service (E-MBS) performance.

Minimum performance requirements for E-MBS, expressed in terms of spectral efficiency over the coverage area of the service, appear in Table 6.

Table 6. MBS minimum spectral efficiency vs. inter-site distance.

Inter-Site Distance (km)	Min. Spectral Efficiency (bps/Hz)
0.5	2.0
1.5	1.0

The following notes apply to Table :

1. The performance requirements apply to a wide-area multi-cell multicast broadcast single frequency network (MBSFN).
2. The specified spectral efficiencies neglect overhead due to ancillary functions (such as synchronization and common control channel) and apply to both mixed unicast-broadcast and dedicated MBS carriers, where the performance is scalable with carrier frequency bandwidth.

.