Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Draft IEEE 802.16m System Requirements: Section 7: Performance Requirements**
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Re:	Call for contributions regarding P802.16m project, 1/22/2007
Abstract	This document contains proposed system-level and service requirements for IEEE 802.16m standard.
Purpose	For discussion and approval by TGm
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7.0 Performance requirements

The performance requirements are specified in terms of relative performance with respect to that of the 802.16e reference system. The following sections contain the requirements for mobile and base stations.

7.1 User throughput

The average user-throughput in the downlink and in the uplink of IEEE 802.16m system shall be at least 2x relative to that of the 802.16e reference system.

Note that the Cell Edge 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. This metric is separately provided for uplink and downlink.

7.2 Spectrum efficiency

The requirements for the peak, sustained, and equal data spectral efficiencies and sector throughput for the mobile and base stations (whichever applies) are as follows. These requirements shall be met with the baseline antenna configuration. At least 50% improvement over the 802.16e reference system is required.

Performance Metric	Required Value	Comments
DL Data Rates		
Peak Spectral Efficiency/Sector (Full-Buffer Data Traffic)	> 6.4 bps/Hz/Sector	The maximum achievable number of successfully transmitted information bits per second per Hz that a sector can serve in a fully loaded network with full-buffer data traffic. This metric is separately provided for uplink and downlink by only considering the PHY-related (L1) overhead (separately for each link).
Sustained Spectral Efficiency (Full-Buffer Data Traffic)	> 7.5 bps/Hz/Cell	The number of successfully transmitted information bits per second per Hz that a site can serve for a given DL:UL ratio, given number of users, site-to-site distance, and a given fairness and delay criterion in a fully loaded network with full-buffer traffic. This metric is separately provided for uplink and downlink by considering both PHY- and MAC-related (L1+L2) overhead (separately for each link).
Sector Throughput DL:UL=2:1 for TDD duplex scheme, 10 MHz bandwidth	> 16 Mbps	The number of successfully transmitted information bits per second that a sector can serve for a given DL:UL ratio, 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. This metric is separately provided for uplink and downlink by considering both PHY- and MAC-related (L1+L2) overhead (separately for each link).
Equal Data Spectral Efficiency (bps/Hz/Sector)	> 2x the 802.16e reference	It is the harmonic mean of the throughput divided by the band width. Assume total bandwidth W, # of users N with throughput $S1, S2, ... SN$, hence

	system	$SE_{ED}=(N/W)*1/(1/S1+1/S2+...+1/SN)$
UL Data Rates		
Peak Spectral Efficiency (Full-Buffer Data Traffic)	> 3 bps/Hz/Sector	The maximum achievable number of successfully transmitted information bits per second per Hz that a sector can serve in a fully loaded network with full-buffer data traffic. This metric is separately provided for uplink and downlink by only considering the PHY-related (L1) overhead (separately for each link).
Sustained Spectral Efficiency (Full-Buffer Data Traffic)	> 3.5 bps/Hz/Cell	The number of successfully transmitted information bits per second per Hz that a site can serve for a given DL:UL ratio, given number of users, site-to-site distance, and a given fairness and delay criterion in a fully loaded network with full-buffer traffic. This metric is separately provided for uplink and downlink by considering both PHY- and MAC-related (L1+L2) overhead (separately for each link).
Sector Throughput DL:UL=2:1 for TDD duplex scheme, 10 MHz bandwidth	> 4 Mbps	The number of successfully transmitted information bits per second that a sector can serve for a given DL:UL ratio, 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. This metric is separately provided for uplink and downlink by considering both PHY- and MAC-related (L1+L2) overhead (separately for each link).
Equal Data Spectral Efficiency (bps/Hz/Sector)	> 2x the 802.16e reference system	It is the harmonic mean of the throughput divided by the band width. Assume total bandwidth W, # of users N with throughput $S1, S2, ... SN$, hence $SE_{ED}=(N/W)*1/(1/S1+1/S2+...+1/SN)$

7.3 Mobility

The IEEE 802.16m amendment shall include air-interface features that would enable the Seamless Mobility with 802.16e systems. Handoff with other IMT-2000 standards shall also be given consideration. This requirement is intended to address additional air-link requirements beyond those covered by the IEEE 802.21 working group. For example, specific methods for scanning and system discovery should be considered as part of the 802.16m MAC. Finally, requirements for handoff of broadcast services shall also be defined.

The expectations for performance should tiered based on mobility speeds and prioritized in order to achieve the optimum overall performance. 802.16m shall support mobile speeds up to 350 km/h. It should provide optimal system performance for vehicular speeds less than 15 km/h, high performance between 15-120 km/h and graceful degradation of performance between 120-350 km/h to maintain session/call connectivity.

Note that the requirements for handover are captured under latency requirements.

7.4 Coverage

The IEEE 802.16m shall provide significant enhancements relative to the 802.16e reference system with respect to coverage. The downlink and uplink link budget shall be improved by at least 3 dB assuming the same baseline antenna configuration and RF channel bandwidth as the 802.16e reference system.

For cell sizes up to 5 km, the user throughput, spectral efficiency, and mobility support requirements should be met. For cell sizes up to 30 km, slight degradations in the achieved user throughput and more significant degradation in spectral efficiency are acceptable; however mobility performance targets should be met. Cell sizes up to 100 km, should not be precluded by the specifications.

7.5   Voice-over-IP

IEEE 802.16m VoIP capacity shall be significantly higher than that of the 802.16e reference system. The VoIP capacity and call setup latency for the 802.16m systems shall satisfy the following requirements:

Feature	Requirement	Comments
Number of VoIP Users/Sector (per MHz) Number of concurrent VoIP sessions/sector/MHz in a system fully loaded only with VoIP users	> 100 users/sector/FDD MHz > 50 users/sector/TDD MHz	System outage and FER shall be less than 3% and 3%, respectively. AMR shall be used as the default codec and 12.2 kbps with DTX enabled shall be considered as the default source rate.
VoIP (and PTT) call setup latency	< 1s	

7.6   Data Services

IEEE 802.16m aggregate TCP capacity shall be at least 2x relative to that of the 802.16e reference system. The aggregate TCP capacity is defined as the sum of the TCP goodputs of all the users in a sector. It is measured above the TCP layer.

7.7   Enhanced Location-Based Services (LBS)

IEEE 802.16m systems should provide support for enhanced LBS. The IEEE 802.16m should satisfy the following requirements:

Feature	Requirement	Comments
Location based services	Location Determination Latency < 1 s	To maintain session/call connectivity at high vehicular speeds
	Position Accuracy 50-250 m	Need to meet E911 Phase II Requirements

7.8   Enhanced Broadcast and Multicast Service (MBS)

The performance of IEEE 802.16m broadcast and multicast services should be evaluated independently of unicast services. The video capacity of IEEE 802.16m MBS should be > 2x of that of the 802.16e reference system assuming the entire physical resources are utilized for multicast and broadcast service.

Feature	Requirement	Comments
MBS channel switching time	< 1 s	
MBS video channel capacity	> 2x the 802.16e reference system	H.264/AVC shall be supported as the default video codec for evaluation purposes. AAC/AAC+ shall be supported as the default audio codec for evaluation purposes.