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Re:	Call for Contributions on Requirements for 802.16m – Advanced Air Interface, 01/18/07
Abstract	This contribution provides the performance requirements of advanced air interface for the IEEE 802.16m. In order to specify and realize the ultimate goals that should be met by the IEEE 802.16m as the next generation mobile networks, this contribution propose the specific requirements including user throughput, spectral efficiency, mobility, coverage, and enhanced multicast-broadcast.
Purpose	For discussion and approval by TGM
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Section 7 - Performance requirements for IEEE 802.16m

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1. Abstract

This contribution provides the performance requirements of the advanced air interface for the IEEE 802.16m. In order to specify and realize the ultimate goals that should be met as the next generation mobile networks, this contribution proposes the specific requirements including user throughput, spectral efficiency, mobility, coverage, and enhanced multicast-broadcast.

2. Background

According to the project scope in the IEEE 802.16m PAR and the system requirements for the IEEE 802.16m [1], an advanced air interface for the IEEE 802.16m shall meet the cellular layer requirements of IMT-Advanced next generation mobile networks. As identified in the ITU-R M.1645 [2] and recent related documents [3], [4], the general features for IMT-Advanced radio interface have been described as follows:

- High degree of commonality of design worldwide
- Compatibility of services within IMT-Advanced and with the fixed networks
- Small and cheap terminal suitable for worldwide use
- Potential to support larger cell
- Supporting high mobility environment
- Worldwide roaming capability and ubiquitous access
- Capability for multimedia applications within a wide range of services and terminals

Furthermore, the key technologies that should be required to develop the systems beyond IMT-2000 have been also discussed in the various areas such as system related technologies, access networks & radio interfaces, utilization of spectrum, mobile terminals, and applications [2]. It is expecting that the potential technologies with new radio interfaces facilitate supporting high data rates of up to 100Mbps for mobile access and 1Gbps for nomadic/local wireless access.

Taking into account the trends and directions regarding the system requirements for the IMT-Advanced, it is naturally essential to further clarify and specify the performance goals that could be necessary to develop the IEEE 802.16m. In this contribution, the performance requirements, which are itemized in section 7 in [1] as one of key issues on the system requirements, are focused and the specific texts will be also provided.

2.1 Performance Requirements for IEEE 802.16m

In order to realize the performance goals that should be met by the IEEE 802.16m as the next generation mobile networks, the performance requirements regarding user throughput (clause 7.1), spectral efficiency (clause 7.2), mobility (clause 7.3), coverage (clause 7.4), and enhanced multicast-broadcast (clause 7.5) in [1] are further considered as follows.

7.1 User throughput

The cell edge user throughput for the IEEE 802.16m should be considered together with the average user throughput, since the cell-edge users, especially in the large cell environment, may be limited to obtain the benefits from the potential key technologies deployed in the IEEE 802.16m. The text proposal regarding user throughput in this contribution should be met by IEEE 802.16m in order to be consistent in supporting all users

even in large cell environment.

7.2 Spectrum efficiency

Considering the requirements of mobility in clause 7.3, the text proposal regarding the spectral efficiency in this contribution should be met by the IEEE 802.16m in the various mobility environments.

7.3 Mobility

According to the Recommendation ITU-R M.1034-1 and the ITU-R document 8F/TEMP/496-E [3], the mobility classes for the cellular systems including IMT-Advanced can be described as follows:

- Stationary (i.e., can be used as a fixed wireless access systems)
- Pedestrian (Walking speed of several km/hr)
- Typical Vehicular (Automobile speed of one hundred and several tens km/hr)
- High Speed Vehicular (High speed train up to 500km/hr)

This implies that the IMT-Advanced system shall optimize at low vehicular speed as well as support vehicular speed up to 500 km/hr.

Furthermore, since users shall have service continuity irrespective of underlying radio interfaces, as mentioned in [2], the IMT-Advanced system shall support seamless handover among different radio access technologies while meeting other requirements in section 7.

In line with the requirements of the spectral efficiency in clause 7.2, the text proposal regarding mobility in this contribution should be met by IEEE 802.16m in order to be consistent in supporting all classes of mobility and seamless service continuity from/to different access systems to/from the IEEE 802.16m cellular network.

7.4 Coverage

According to the recent documents for the requirements of IMT-Advanced system in [3], a cell radius over 50 km should be considered and supported. This implies that the proper configuration of the system parameters is required to be consistent in support of cellular networks with various cell sizes. Considering the requirements of user throughput, spectral efficiency, and mobility in the previous clauses, the text proposal regarding the coverage in this contribution should be met by the IEEE 802.16m.

7.5 Enhanced Multicast-Broadcast

The multicast-broadcast service (MBS) is targeting the delivery of multimedia contents to more than one user from single source over common radio resource for the various applications such as telematics, weather broadcast, music streaming, sports replay, video clip, file sharing, etc. Considering the potential demands on the variety of applications with the increased efficiency of the channel utilization, the text proposal regarding enhanced MBS in this contribution should be met by the IEEE 802.16m .

3. Proposed Performance Requirements for IEEE 802.16m

[Based on the above considerations on the performance requirements for the IEEE 802.16m, the specific text proposals regarding user throughput (clause 7.1), spectral efficiency (clause 7.2), mobility (clause 7.3), coverage (clause 7.4), and enhanced multicast broadcast (clause 7.5) in [1] are given as follows.]

7.1 User throughput

Along with the average user throughput, the target user throughput for cell-edge users required for IEEE 802.16m shall be considered differently due to the potentially limited benefits from the key technologies, which might be deployed in IEEE 802.16m.

- The DL or UL average user throughput over a cell shall be at least 2 times that of the legacy 802.16e system.
- The 5 % point of CDF of user throughput shall be at least 2 times that of the 802.16 reference system in both DL and UL.
- The cell-edge user shall support the peak user throughput described in clause 6.1.

[Editor's Note: Move Definition to the definition part (Section 3.0) of the document]
Definition:

- User throughput : the number of information bits per second that a user can deliver or be received successfully.

7.2 Spectrum efficiency

The IEEE 802.16m shall at least meet the spectral efficiency in Table 1, which is defined as the ratio of the aggregate throughput excluding any overhead associated with PHY and MAC layer signaling to the system bandwidth under various mobility conditions on the assumption of 2 2 MIMO configuration. The system bandwidth is defined as a bandwidth occupied by the system excluding guard band.

Table 1. Spectral Efficiency for IEEE 802.16m (FFS)

Mobility	DL Spectral efficiency in bps/Hz/Sector		UL Spectral efficiency in bps/Hz/Sector	
	Peak	Average*	Peak	Average*
3 km/h	6.0	2.0	3.5	1.2
60 km/h	4.2	TBD	2.5	TBD
120 km/h	2.4	1.5	1.5	0.9
300 km/h or higher	0.5	TBD	0.3	TBD

* : for full loading case

The spectral efficiency at relatively higher vehicular speeds than those shown above will degrade gracefully. Furthermore, it is highly demanded that the L1/L2 signaling overhead shall be optimized in order to achieve the requirements of spectral efficiency.

7.3 Mobility

The IEEE 802.16m shall be optimized for low vehicular speeds such as mobility classes from stationary (0 km/hr) to pedestrian (10 km/hr) and provide high performance for higher mobility classes between 10 and 120 km/h. The performance shall be degraded gracefully at the relatively higher mobility up to 500 km/hr. In addition, the IEEE 802.16m shall be designed to maintain the connection up to 500 km/hr and to support the required spectral efficiency described in clause 7.2. Especially, it is required that at least 1% packet error rate for common control channel shall be given for 95% users in the cell over a variety of cell layouts (clause 7.4) and mobility classes.

The IEEE 802.16m shall support the interoperability with other radio access technologies and provide the seamless handover in order to improve user experiences of mobile terminals between different types of radio access technologies including the legacy systems.

7.4 Coverage

The IEEE 802.16m shall operate at the various cell sizes up to a cell radius of 50 km. Along with achieving the requirements of cell-edge user throughput (clause 7.1) and spectral efficiency (clause 7.2) with various mobility classes (clause 7.3), the IEEE 802.16m shall be flexible enough to support all users having various coverage requirements in the cellular networks. In addition, it is highly demanded that the PHY- and MAC-related system parameters shall be properly configured by taking into account the large cell environment.

7.5 Enhanced Multicast-Broadcast

The IEEE 802.16m shall support enhanced multicast-broadcast service for IMT-Advanced multimedia multicast broadcast services in a spectrally efficient manner. The IEEE 802.16m enhanced multicast-broadcast shall support the coverage up to 50km of a cell radius. The IEEE 802.16m enhanced MBS shall provide low user power consumption and flexible radio resource allocation mechanism.

References

[1] IEEE C802.16m-07/002: “Draft IEEE 802.16m Requirements,” January 2007.

[2] Recommendation ITU-R M.1645: “Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000,” January 2003.

[3] ITU-R Document 8F/TEMP/496-E: “Draft [Report on] Requirements Related to Technical System Performance for IMT-Advanced Radio Interface(s),” January 2007.

[4] IEEE C802.16m-07/007: “IEEE 802.16m Requirements,” LG Electronics, January 2007.

[5] TTA CJK B3G White Paper Part I : System Requirement- chapter 4 and 5, October 2006.

[6] IEEE Std 802.16-2004, “IEEE Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed Broadband Wireless Access Systems.”

[7] IEEE Std 802.16e-2005, IEEE Std 802.16-2004/Cor 1-2005, “IEEE Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1.”

[8] P802.16-2004/Cor2/D2, “Draft Standard for Local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Corrigendum 2.”

[9] IEEE C802.16m-07/xxx: “Draft IEEE 802.16m Evaluation Methodology and Key Criteria for 802.16m – Advanced Air Interface,” LG Electronics, March 2007.