Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Recommended IEEE 802.16m Requirements Text for Section 6.0**
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Re:	Response to call for contributions on requirements for P802.16m – Advanced Air Interface
Abstract	This document proposes text for Section 6.0
Purpose	For consideration of 802.16 TGm Requirements drafting group
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6.0Functional Requirements

6.1 Peak Data Rate

State of the art modulation, coding, scheduling and multiplexing should be employed to achieve higher spectral efficiency at a reasonable complexity

Additional transmit and receive antennas may be considered but should not be required of subscriber devices. Size and power considerations continue to dictate that no more than one transmit antenna and two receive antennas be required of hand-held devices. The same considerations impact supportable higher order constellation order.

Accordingly, the minimum peak rate requirement supported by mobile stations compliant with the 802.16m specification, expressed as a peak rate spectral efficiency (i.e. absolute maximum supported data rate divided by the occupied channel bandwidth) is specified in Table X.

Link Direction	Min. No. of Active MS Antennas	Min. No. of Spatial Sub-streams	Min. Modulation Order	Min. Peak Rate Spectral Efficiency (bps/Hz)
Downlink (BS->MS)	2 (Receive)	2	64-QAM	6.5
Uplink (MS->BS)	1 (Transmit)	1	64-QAM	2.5

Table X – Minimum supported peak spectral efficiencies.

Notes applicable to Table X:

1. The specified minimum supported peak spectral efficiencies are not distinguished by duplex mode. Rather, 100% of radio resources are assumed – for the purposes of computing Table X – allocable to downlink and uplink respectively regardless of duplexing mode.
2. Table X specifies minimum supported peak spectral efficiencies applicable to all devices supporting 802.16m. Modes offering further enhanced peak spectral efficiencies may, however, be specified.
3. Table X excludes overhead due to provisioning of radio resources for essential functions such as synchronisation, common control channel signalling, guard intervals, etc. which would be expected to reduce achievable peak spectral efficiency.
4. The specified minimum supported peak spectral efficiencies are applicable to all bandwidths specified in Section 5. For example, for mobile stations supporting a 20MHz bandwidth, the minimum supportable peak rate (excluding overhead) is 130Mbps.

[Further peak rate requirements, such as coverage-averaged sustainable peak rates, may be further studied and could be specified following agreement on usage scenarios.]

6.2 Latency

Latency should be further reduced as compared to the IEEE 802.16e reference system for all aspects of the system including the air link, state transition delay, access delay, and handover.

6.2.1 Data Latency

Requirements for air link data latency are specified in terms of the time for delivery of a MAC PDU, transmissible as a Layer 1 codeword (i.e. without fragmentation), from the MAC interface of a base station or mobile station entity to the MAC interface of the corresponding mobile station or base station entity, excluding any scheduling delay at the base station. A single Layer 1 re-transmission of the codeword is included in the definition. The corresponding maximum latency for deliver of the MAC PDU appears in Table Y.

Link Direction	Max. Latency (ms)
Downlink (BS->MS)	20.0
Uplink (MS->BS)	20.0

Table Y – Maximum data latencies.

6.2.2 State Transition Delay

Performance requirements for state transition delay may be divided into transition delay requirements for transition from SLEEP mode to ACTIVE mode and from IDLE mode to ACTIVE mode. The following requirements apply.

1. Delay performance requirements for mobile stations transitioning from SLEEP mode to ACTIVE mode shall be aligned with the reference system.
2. The 802.16m specification shall support mobile station transition times from IDLE mode to ACTIVE mode less than or equal to 100ms.

6.2.3 Handover Delay and Interruption Times

Handover performance requirements, and specifically the interruption times applicable to handovers, are differentiated according to real-time and non-real-time service handover, handover between base stations supporting 802.16e and 802.16m, and intra- and inter-frequency handover.

The maximum service interruption times specified in Table 1 apply to handover of mobile stations supporting 802.16m between base stations supporting 802.16m and operating in the absence of 802.16e-2005 mobile stations.

Handover Type	Max. Interruption Time (ms)
Non-real-time, Intra-Frequency	100.0
Non-real-time, Inter-Frequency	300.0

Real Time, Intra-Frequency	50.0
Real Time, Inter-Frequency	150.0

Table W – Handover maximum interruption times.

6.3 QoS

Relative to IMT-2000 systems, the 16m amendment shall

have a greater ability to simultaneously support a wide range of multimedia services,

provide enhanced management of different quality of service levels, and

provide support for applications requiring IMT-Advanced system end user QoS requirements.

Further, support shall be provided for preserving QoS when switching between networks associated with other radio access technologies (RAT's).

The system shall support the necessary mechanisms and fields to enable content-awareness and definition of flow priorities and packet priorities within a flow at the lower (MAC/PHY) layers.

6.4 Radio Resource Management

The 802.16m amendment shall define methods for optimising base station and network selection, including selection based on application layer requirements, between 802.16 variants (specifically, 802.16e reference systems, and networks and base stations supporting the 802.16m amendment) and other radio access technologies (RAT's). Such support shall include initial network access and IDLE mode procedures.

Further, support shall be provided for optimised network selection with respect to at least the following RAT's:

IEEE 802.11x networks

3GPP GSM/EDGE, UMTS WCDMA, and LTE networks

3GPP2 CDMA2000 networks

The system shall enable advanced radio resource management by enabling the collection of reliable statistics at different "scales", such as system (dropped call statistics), user (terminal capabilities, mobility statistics, battery life), flow, packet, etc.

The system shall provide enhanced uplink transmission efficiency by expanding the freedom on the part of the MS to decide on the exact scheduling of uplink data packets on a micro time scale.

6.5 Security

The system shall include a security function which provides the necessary means to achieve:

- Protection of system integrity

- Protection and confidentiality of user-generated traffic and user-related data
- Secure access to and secure provisioning of services provided by the system.

The security function shall be self-contained and capable of maintaining security without relying on specific behaviors on the part of algorithms/protocols at any other functions or layers outside the security function. Such assumptions, if and when necessary, shall be explicitly specified.

The impact of security procedures on the performance of other system procedures, such as handover procedures, shall be minimized.

Roaming users and users performing inter-technology handover shall not be prevented from accessing the maximum level of security provided by the system.

6.6 Inter-RAT Mobility

The 802.16m amendment shall fully support ACTIVE mode handover between 802.16e reference base stations, and base stations supporting the 802.16m amendment.

The 802.16m amendment shall specify means of reporting ACTIVE mode measurement of additional radio access technologies (RAT's) including at least the following RAT's:

IEEE 802.11x networks

3GPP GSM/EDGE, UMTS WCDMA, and LTE networks

3GPP2 CDMA2000 networks

In addition, the 802.16m amendment shall provide support for optimised ACTIVE mode handover procedures between base stations supporting the 820.16m amendments and the RAT's specified above.

6.7 Enhanced Multicast Broadcast Service (MBS)

The 802.16m amendment shall provide support for an evolved Multicast Broadcast Service (E-MBS). As well as providing enhanced multicast and broadcast spectral efficiency (Section 7), E-MBS shall provide the following functional enhancements with respect to the reference 802.16e system:

Optimised scheduling and resource allocation overhead reduction

Reduced mobile station power consumption while monitoring

Enhanced broadcast quality of service (QoS) and coverage optimization

MS MBS decoding of pre-defined MBS channel(s) without requiring network registration

The 802.16m amendment shall be structured in such a way that dedicated carrier modes of operation (i.e. where most, or all, of the radio resources on a specific carrier frequency are assigned for MBS use) may be applied as a means of achieving the goals above.

The system shall support seamless switching between broadcast and unicast services, including the case when broadcast and unicast services are deployed on different frequencies.

6.7.1 MBS Channel Reselection Delay and Interruption Times

E-MBS functionality defined as part of the 802.16m amendment shall support the following requirements for maximum MBS channel change interruption times when applied to broadcast streaming media.

MBS Channel Reselection Mode	Max. Interruption Time (s)
Intra-frequency	1.0
Inter-frequency	1.5

Table Z – MBS channel reselection maximum interruption times.

Note that requirements of Table Z apply to the interruption time between terminating delivery of MAC PDU's from a first MBS service to the MAC layer of the mobile station, and the time of commencement of delivery of MAC PDU's from a second MBS service to the mobile station MAC layer.

In addition, the requirements of Table WW specify the maximum user-perceived channel reselection time (i.e. the time from channel re-selection by the user to the start of media stream rendering by the mobile station).

MBS Channel Reselection Mode	Max. Interruption Time (s)
Intra-frequency	2.0
Inter-frequency	3.0

Table WW – MBS user-perceived maximum interruption times.

6.8 Location Based Services (LBS)

The 802.16m amendment shall provide optimised support for assisted modes of global navigation satellite systems (A-GNSS). 802.16m shall also support location based services using only native 802.16m transmissions.

6.9 Reduction of User Overhead

The system shall provide mechanisms for reducing overhead already present in a bearer stream, by natively supporting improved and efficient header compression schemes, capable of suppressing overhead caused by IP/TCP layers, as well as other vital applications, such as VPN, PPPoE etc.

6.10 System Overhead

The percentage of system resources consumed consumed by overhead, including overhead for control signaling procedures as well as overhead related to bearer data transfer, should be minimized.

6.11 Enhanced Power Saving

The 802.16m amendment shall provide support for enhanced power saving functionality to help reduce power consumption in client devices during multimedia services such as push-to-X and also when the device is idle. The following functional enhancements with respect to the reference 802.16e system are possible:

Optimized sleep to scan and scan to sleep mode switching

Automatic sleep mode reactivation provided by the BS

Optimized sleep mode deactivation/reactivation by MS

Optimized paging message indication and decoding