

Responses to MBWA ECSG Group Comments on 802.16e PAR

Introduction

The following are our comments on the 802.16e PAR as contained in http://grouper.ieee.org/groups/802/16/docs/02/80216-02_48r1.pdf. Our comments address concern about the following aspects of the PAR and Five Criteria:

1. Uniqueness of the project
2. Demonstration of technical feasibility
3. Backward compatibility issues

Scope Overlap:

The 802.16e PAR was developed with full knowledge of the MBWA PAR, as shown in item 15 of 802.16-02/48r1. As submitted, the two PARs substantially overlap with respect to their target markets and performance objectives. This has created a problem of uniqueness between the two projects if they are both to be approved. In our view there are two potential solutions to the problems that may be acceptable to the SEC. One approach is to revise the scope of the 802.16e PAR to providing support for limited mobility on a standard that is fully backward compatible with 802.16a.

[As suggested, the 802.16e PAR has been clarified thus eliminating the perceived overlap. For example, the 802.16e PAR now clearly states the requirement for full backward compatibility.](#)

Alternatively, the objectives of the 802.16e PAR can be included in the MBWA ECSG PAR by extending its scope to allow for consideration of proposals derived from the 802.16a standard by a new MBWA Working Group.

[With a requirement for full backward compatibility with 802.16a it seems logical for this work to be done within the 802.16 Working Group.](#)

Concerns with Extending a Legacy Standard for Mobility

What are the advantages of extending the 802.16 fixed wireless solution to high mobility vs. a solution optimized for mobility requirements (that may include 802.16a PHY or MAC)?

[It was never our intent to provide a solution optimized solely for mobility. The proposed amendment is an upgrade to 802.16a which provides mobile capability to existing as well as new 802.16a users operating in a common network without compromising the high quality of service available to fixed users. Due to the wide bandwidths of 802.16a, the data rates provided to mobile users would be much higher than the data rates in existing or proposed standards. The inherent QoS provisions in 802.16a would also be available to mobile users. Combined, the higher data rates and QoS provisions would enable more advanced applications and services.](#)

We do not believe that full vehicular mobility is possible by a simple extension to fixed wireless systems. It is our contention that mobility support is a non-trivial functionality of the system that goes beyond just handoffs and fast multipath fading.

Although not optimized for mobility, the current 802.16a standard already contains the basis for a mobile system with features such as Transmit Power Control, Adaptive Modulation, Frame Synchronization and others. Similar systems from a variety of vendors have already been successfully tested in a mobile environment.

A new standard, unencumbered by legacy air interface and system architectures, developed and optimized for data mobility, better serves the need for a mobile broadband standard.

Although 802.16a can be upgraded to provide mobile operation, it was never our intent to provide a solution optimized solely for mobility. This is already being performed by the existing 3G Partnership Projects.

This study group feels that attempting to leverage an existing standard designed for a different purpose sets the stage for a sub-standard standard, albeit completed in marginally shorter time.

Based on the clarified PAR, we believe that this comment no longer applies.

We believe that such a standard would not find acceptance in the marketplace.

The group has already received direct communications indicating industry interest in the proposed 802.16e amendment.

There has been no evidence presented that enhancements to fixed services standards to support mobility will substantially shorten development time.

We do not fully understand this comment.

Furthermore, there has been no comment and analysis presented on the potential impacts on the existing fixed services standards.

The proposed PAR dictates that there be no negative impact to the existing fixed users.

Backwards Compatibility with 802.16/802.16a.

The scope of the PAR indicates that the proposed amendment is intended to serve combined sets of fixed and mobile subscriber stations, with high spectral efficiency even when the subscribers are moving at high speeds. The amended standard should support backward compatibility in the sense that stations conformant to the 802.16a standard will be able to work as fixed stations in this mixed environment without impact on their performance.

[The 802.16e PAR has been amended to incorporate this requirement.](#)

Are there any features (especially, mandatory ones) in the existing standard that will likely have an adverse impact on mobility? In that case, on what basis will tradeoffs be made?

[There is nothing immediately obvious in the existing standard that we have identified as having an adverse effect on mobility. As the standard is developed the PAR requirement for no impact on fixed performance will be a prime factor in any tradeoff decisions.](#)

Technical feasibility of extending the 802.16a MAC & PHY up to 250km/h.

- The PAR asserts that 802.16/802.16a fixed wireless systems that have been designed and optimized for stationary terminals can be extended to handle a cellular network involving high-speed mobile terminals (e.g., with high Doppler, fast multipath fading, intercell interference, mobiles rapidly moving in and out of cells, etc.) As per the Call for Contributions by the 802.16 MWMAN SG (http://grouper.ieee.org/groups/802/16/mobile/docs/C80216sgm-02_08.pdf), we believe that a study needs to be completed before technical feasibility can be claimed in the Five Criteria. (See also contributions http://grouper.ieee.org/groups/802/16/mobile/contrib/C80216sgm-02_01.pdf, http://grouper.ieee.org/groups/802/16/mobile/contrib/C80216sgm-02_05r1.pdf, and http://grouper.ieee.org/groups/802/16/mobile/contrib/C80216sgm-02_21.pdf)

[We see no reason to preclude the use of 802.16a in a mobile environment. In fact the above referenced submission \(C80216sgm-02_01.pdf\) states that "there seem to be no initial show-stoppers to extend the IEEE 802.16 MAC to facilitate mobility support." The same contribution, and others, did however identify some specific PHY areas where additional work may be necessary. This work would be accomplished under the proposed project.](#)

- Experimental evidence has been provided to show that the PHY layers of non-802.16a-compliant system can support high-speed mobility. While there may be similarities in the use of OFDM in the PHY, these involve broadcast systems or proprietary systems that have substantially different MACs (http://grouper.ieee.org/groups/802/16/mobile/contrib/C80216sgm-02_22.pdf, http://grouper.ieee.org/groups/802/16/mobile/contrib/C80216sgm-02_23.pdf). Also, the mobile terminal form factors in these examples are significantly different than those required for mobile communications (e.g., they draw power from automobiles or power grids). We do not believe this evidence establishes sufficient proof of technical feasibility for extending 802.16a to support full vehicular mobility.

Since the 802.16a standard is just now reaching completion, there are no fully compliant systems available to test mobility features. However, tests performed with similar systems do indicate the support for mobility.

- Contemporary mobile wireless system designed for vehicular mobility utilize fast, dedicated control channels for critical MAC and PHY functions such as power control, timing control, ARQ acknowledgements, uplink requests, etc. These functions needs to be performed at significantly higher rates than in fixed systems, such as 802.16/802.16a, where message streams with significant built-in overheads are used for signaling. To efficiently support full vehicular mobility for a large number of users in a wireless MAN, these enhancements will require fundamental and extensive changes to the existing MAC, leading to potential incompatibilities. These are complex MAC changes.

The current 802.16a standard is capable of updating all of the listed parameters on a frame by frame basis. This update rate is already comparable to the rates used in existing mobile systems.

In a system such as 802.11 that supports limited station mobility, the MAC provides for over 100 different related messages. The 802.16 MAC, with no support for station mobility, defines less than 20 MAC messages. This suggests that a substantial increase in MAC messages and complexity will be required if vehicular mobility is to be supported by the 802.16 MAC.

The MAC messages in 802.16a are TLV (Type Length Value) based and therefore are very flexible and readily extended to support new features such as mobility.

Handoff Related Concerns

Slide 8 of the *Handoff Functional Elements* tutorial (reproduced below) shows that 802.16 lacks many of the functional elements required to support handoff. What is the impact on the PHY and MAC of having to support these functional elements?

Specifically will the PHY and MAC remain backward compatible with the 802.16/802.16a PHY and MAC? What performance penalty does the need to transfer Handoff information impose on the air-link throughput? We do not believe these elements can be developed and standardized in the proposed one year time frame.

As the standard is developed, the mechanisms to support handoff will be incorporated. As previously indicated, no performance degradation to fixed users will be the prime factor in design decisions. We are confident that this can be accomplished within the stated one year time frame.

WIRELESS SYSTEM (RAT)

H/O Function	802.11	802.16	GSM	W-CDMA	CDMA2K
Initial channel scan	yes	yes	yes	yes	yes
Initial inter-RAT scan	no	no	no	limited	?
Useable Cell Selection	yes	yes	yes	yes	yes
Rcv Sys Info/Neighbor List	limited	limited	yes	yes	yes
Search for Neighbor Cells	limited	no	limited	limited	limited
Measure Source Quality	yes	yes	yes	yes	yes
Sched Measure Opportunity	no	no	yes	yes	yes
Measure Neighbor Quality	limited	no	yes	yes	yes
Report Measurements	no	no	yes	yes	yes
H/O Decision Element	STA	N/A	Network RRM	Network RRM	Network RRM
Scheduled H/O	no	no	optional	optional	optional
Hard H/O	yes	no	yes	yes	yes
Soft H/O	N/A	N/A	N/A	optional	optional