

802.16e requirements from an operator's perspective

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Source:

Anthony (Tony) Klinkert
WorldCom
6828 Colonnade Drive
Plano, Texas 75024

Voice: 972-618-6400

Fax:

E-mail: Info@Klinkert.net

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Purpose:

This document provides a view from an operator's perspective on requirements for a mobile extension to 802.16a.

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802.16e System Requirements

Feedback from an operator perspective

The opinions expressed in this presentation are solely those of the author, and not those of the WCA nor of WorldCom.

Delivered By
Tony Klinkert
Engineering Committee - Vice Chairman, WCA
Director, Next Generation Network, WorldCom

Introduction



- The IEEE asked participants to provide feedback to the 802.16e task group currently assembling requirements for the extension of 802.16a (fixed point to multipoint) to 802.16e (mobile) broadband wireless standards.
- Contained herein are comments on these recommendations for future collaboration.

S1-S3



- **S1: Operating frequencies: < 6GHz**
 - A focus on this segment is satisfactory but this requirement should not limit manufacture of equipment on the high end (up to 11 GHz) and the low end (down to 700 MHz).
- **S2: Support of both fixed and mobile services**
 - It is satisfactory to require performance evaluation at 75 km/h (city street speed)
 - And it is a satisfactory to require informative evaluation at 150 km/h
 - Note this requirement addresses interoperability between fixed (current 16a standard) and mobile (-16e) systems with the caveats of S3.
 - Note further that given a trade-off between speed and bandwidth, favor bandwidth (optimizing around broadband speeds of 512 Kbps to 2Mbps, not precluding cellular network speeds down to 128 kbps, but this should not be the focus)
- **S3: Full support of the IEEE 802.16a air interface**
 - If additional flexibility for 16e is necessary to meet the priority requirements (see page12) we support recommended changes to 802.16a.

S4: Channel Bandwidths



- **802.16a Channel Bandwidths from 1.25MHz...28 MHz depending upon allocations**
 - It is satisfactory to require channelization between 1.25 and 28 MHz.
 - Note however that the MDS/ITFS rules revision project ([\[Individual company\]mircc](#)), and the “WCA white paper” ([DA-02-2732A1.doc](#)), submitted to the FCC, who then released a request for comment ([DA 02-2732](#)) and an NPRM. It is hoped this effort will move through the NPRM soon and a R&O (4Q03-1Q04) on new rules for the band, including a recommended channelization plan. In light of this, it is recommended the IEEE develop and evaluate channelization and performance in alignment, to the extent possible, with this initiative.
- **e.g., 3.5 & 7 MHz in the 3.5 GHz, and 5 &10 MHz in the mobile bands**
 - It is satisfactory to provide these channel spacings for proposal performance evaluation with 5.5 MHz (per the white paper mask) be used at the MMDS band.

S5-S6



- **S5: Support for ITU-R mobile QoS classes: conversational, streaming, interactive, background.**
 - This requirement is satisfactory provided it supports real-time applications (for example using RTP), with the ability to provide the appropriate latency and priority (for example of 802.1 p and 802.1 q schemes).
- **S6: Support vehicular terminals and battery operated devices (e.g., laptops, tablets, and to an extent, PDAs, mobile phones)**
 - This requirement is satisfactory.
 - It is suggested that optimization occur around broadband applications (with real-time traffic in the 0.5 to 2 Mbps range such as video, high fidelity audio and bandwidth intensive interactive applications) versus around store and forward, cellular-bandwidth-class applications such as voice, messaging, personal information manager (PIM), universal messaging (UM), etc.

S7-S10: Cell and deployment types



- **S7: Support for indoor pico-cell (target radius: 100m)**
 - This requirement is supported but notes it is of less priority versus S8 and S9 (place priorities on S8 and S9 over this).
- **S8: Support for outdoor-to-indoor and pedestrian micro-cell (target radius: 100m – 1000m)**
 - This is a supported requirement as a “target” medium range but note that a larger range may offer more implementation flexibility.
 - Notes further this is of lower priority than S9 (optimize S9 over S8)
- **S9: Support for vehicular, high BS antenna macro-cell (target radius: 1–15 km)**
 - This is a supported requirement but no upper limit on range would be better. I.e. range is to be constrained by technology and not by an a priori constraint. Target could be maximum range consistent with a balanced link budget gated by human RADHAZ limits¹ or other factors (size, power, etc.?).
 - Specifically support for macro-cell configuration is important, not necessarily a vehicular configuration.
 - Priority of 1) S9, 2) S8 and 3) S7 can be eliminated (equalized or reversed) if base units have small enough footprint (size) with an-over-the-air back-haul option (that eliminates the need to minimize market-wide number of cell sites thus minimizing recurring expense of real-estate fees and backhaul fees).
- **S10: Support for hierarchical cell operation**
 - This requirement is supported regarding handover, synchronization, and awareness of layers, for interference mitigation, etc.

¹ See regulations for power limits and to balance the needs of high power and long range, constrained by RADHAZ and other regulations

- *Base Station Power*, FCC CFR, Title 47, part 2, section 2.1091 for "Radiofrequency radiation exposure evaluation: mobile devices" pg. 46

- *CPE Power*: FCC regulation in this area may be subject to change based on the WCA white paper that states: "For CPE devices: Licensee and equipment manufactures comport with the restrictions on power contained in Part 1 and 2 that are designed to assure the protection of human health and safety. Specifically, licensees and manufactures are subject to the radiation exposure requirements specified in 1.1307(b), 2.1091, and 2.1093 of the Rules and mandating that applications for equipment authorization of mobile or portable devices operating contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions."

- RADHAZ for mobiles: FCC CFR, Title 47, part 2, section 2.1091 for "Radiofrequency radiation exposure evaluation: mobile devices"

- RADHAZ for portables: FCC CFR, title 47, part 2, section 2.1093 for "Radiofrequency radiation exposure evaluation: portable devices"

- Environmental impact: FCC CFR (Code of Federal Regulation), Title 47, part 1, section 1.1307 for "Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared".

Deployment scenario assumptions for evaluation



Scenario Parameter	Indoor	Outdoor to indoor	Outdoor vehicular
BS Tx power	27 dBm (0.5 W)	36 dBm (4W)	46 dBm (40 W)
SS Tx power	17 dBm	17 dBm	27 dBm
BS ant gain	6 dBi	17 dBi	17 dBi
SS ant gain	0 dBi	0 dBi	3 dBi
BS ant height		15 m	30 m

These values are supported for power levels, antenna gains and antenna heights for evaluation purposes but recommends test points and overlapping ranges on the power levels to emphasize these are scenarios, but not requirements. Ranges on the third scenario could indicate test points with with no upside limitation (e.g., on tower height).

S11-S12



- **S11: Support hand-over between 802.16e BSs and systems**
 - This speaker supports fast, make-before-break handover between single operator systems in a phase one implementation, and between operators in a phase two deployment scenario.
 - To the extent possible, in addition to 802.16e, handover to other standards (particularly 802.11) are considered highly desirable in a phase two standardizing effort.
 - Roaming (“slow handoff”) is essential, seamless make-before-break high speed handoff is desired.
- **S12: Support for both FDD/TDD duplex modes**
 - This speaker supports both FDD and TDD duplex modes.
 - This speaker suggest that for TDD standards, a mode be available (on a per channel basis) to synchronize clocks within a market for co-channel interference mitigation between adjacent (in geography) operators and systems.

S13-S14



- **S1 3: Incorporate power savings in active and standby modes**
 - This speaker supports the need for battery operated devices to conserve battery power, with the focus being on broadband applications and devices.
- **S1 4: Base Station Synchronization is permissible**
 - This speaker supports and notes that this requirement may improve self- and co-channel (neighbor operator) interference, allow high reliability handoff (hand-over, hand-down and hand-up), and robust operation in the presence of noise.

S15-S16



- **S15: Ranging and tracking for vehicular operation**
 - This speaker supports this requirement
- **S16: Power control for vehicular operation**
 - This speaker supports the requirement for ranging, tracking and power control to be adapted to faster channel variations

Additional Requirements



- Maintain high spectral efficiency (B/Hz/km²)
- MAC payload frames capable of 802.1q & p transport (for protocols such as extended Ethernet frames, and to support advanced services requiring MPLS tags, etc.)

Requirement Ranking

- The ranking shown at right marked a, b or c, is provided as a guide to discussions and optimization. There are three classes denoted: a. critical, b. important, and c. desirable (with no special definition attached to these labels, and within a class, no ranking or precedence assigned).
- Additional requirements provided by the speaker are deemed as critical (a).

Qualitative Ranking

a	S9: Support for vehicular, high BS antenna macro cells
a	S6: Support for vehicular terminals and battery operated devices
a	S5: Support for ITU QoS classes
a	S2: Support for both fixed and mobile services
a	S14: Base station synchronization is permissible
a	S13: Incorporate power savings in active and standby modes
a	S12 Support for both FDD and TDD duplex modes
a	S11 Support for hand-over between 802.16e base stations and systems
a	S10: Support for hierarchical cell operation
a	Deployment scenario outdoor vehicular
b	S8: Support for outdoor to indoor and pedestrian micro cells
b	S4: Channel bandwidths from 1.25 to 28 MHz
b	Deployment scenario outdoor to indoor
c	S7: Support for indoor pico cells <100m radius
c	S3: Full support for IEEE 802.16a
c	S1: Operating frequencies <6GHz
c	Deployment scenario indoor

Possible additional work



- Continued definition of these requirements;
- Discussion of higher level requirements to ensure support by these phy/mac level requirements.
- Continued identification of (any?) more requirements important to end users (customer requirements);
- Continued discussions to rank and prioritize requirements after further definition and clarification;
- Process to address trade-offs of key conflicting requirements.

Thank you!



To contact the speaker: Info@Klinkert.net

Notes:

[802.16](#)

[802.16a](#)

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