Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Comments of Part 16: Air Interface for Fixed Broadband Wireless Access Systems**
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Re:	Call for Contributions: IEEE 802.16h
Abstract	These Comments address the General Principles and Policies of proposed 802.16h, specifically in light of the United States Dederal Communication Commissison (FCC) Parts 15.5 and 15.247. The general issue is the possible inconsistency between 802.16h policies and athe said FCC rules. For more that a decade the 802.11 and Bluetooth standards have flourished. Parties responding the FCC's 2003 Notice to foment more efficient use of the 2.4 GHz band did not favor proposed changes to establish a new spectrum etiquette. The comments also address network size, overlapping neighbor networks, entry of new base stations and subscriber stations and 802.16h policy issues relating to them, in particular who will be the database manager and rules arbitrator and how will fair use be assured.
Purpose	It is hoped that members will consider the daunting policy, technical and social issues raised by the proposed 802.16h.
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IEEE Part 16 Draft
Comments on Interference Detection and Prevention
General Architecture and Implementation Considerations

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Operational Principles and Policies

N.B. Excerpts from the IEEE Part 16 Draft appear in *italics*.

2.1.1 General Principles

A possibility of 802.16h usage is in close relation with a database, including both deployment information and an IP identifier for allowing the operation of a technology-independent coexistence approach. It is assumed that:

> *• There is a Server that manage the write/reading of [(a] Data Base, using the 802.16h standardized procedures including secure access procedures; the Server and the country/region data base can be hosted by one of the operators or a trusted entity, like the local Radio Administration.*

IEEE Part 16 vs. FCC Part 15

It can be argued convincingly that in the United States, at least, the proposition of interference detection and prevention is inconsistent with Title 47 of the Code of Federal Regulations, the FCC rules, in particular Parts 15.5 and 15.247. Specifically Part 15.5 sets forth:

> (b) Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM)
> equipment, or by an incidental radiator.
>
> (c) The operator of a radio frequency device shall be required to cease operating the device upon notification by a Commission representative that the device is causing harmful interference. Operation shall not resume until the condition causing the harmful
> interference has been corrected.

As per Part 15.247, a wide variety of devices have been introduced under these rules for business and consumer use, including improved cordless telephones and computer local area networks. Moreover, introduction of industry standards, such as IEEE 802.11 and Bluetooth, have promised to increase both the number and variety of devices that will operate on an unlicensed basis. Overall, the Part 15 rules have been highly successful in fostering the development of new unlicensed devices while protecting authorized users of the radio spectrum from harmful interference.

The Federal Communications Commission released a Notice of Proposed Rulemaking ("Notice") in this proceeding on September 17, 2003. The Notice proposed various changes to update the rules to promote more efficient sharing of spectrum used by unlicensed devices and remove unnecessary regulations that inhibit such sharing. More than sixty parties filed comments in response to the Notice. With the exception of the proposed rule changes to … establish a spectrum etiquette for the unlicensed bands, the comments were generally supportive of the Commission's proposals. Many of the comments included suggested modifications to specific proposals and were intended to clarify certain rule provisions or simplify implementation under FCC rules. By incorporating some of these suggestions, the Commission developed final rules consistent with the goals of increasing spectrum flexibility and fostering technological innovation.

Moreover, certified devices operating 802.11 and Bluetooth protocols will continue to operate without regard to 802.16h to the latter's detriment.

Therefore, the introduction of rules making and governance in the US license-exempt spectrum may be doomed from the start. Nonetheless, it is worth while to dissect the key provisions of the proposed IEEE standard, "Part 16: Air Interface for Fixed Broadband Wireless Access systems: Amendment for improved Coexistence Mechanisms for License-Exempt Operation."

Network Size

• *A community will be limited to a reasonable size; the size limitations and interactions between different neighborhoods: t.b.d.* (to be determined).

This provision is a critical coefficient in determining the overall performance of Part 16, yet the working group gives it a status of "t.b.d."

Quantifying t.b.d.

The comment here is that the bounds of the "reasonable size" of a license-exempt RF network must be determined before all else. Left "t.b.d.," issues such as overlapping neighborhoods, coexistence time slots, and creation of new sub-frames cannot be quantified, let alone prioritized.

Neighbor Networks

The overlapping radio networks create different interference zones, based on spatial distance between transmitters and receivers.

There are three types of overlapping RF zones that are summarized with the following notation:

The duration of each sub-frame, in a given community, is calculated as follows:

for type 1:
- o TTx_sub-frame = TTxMAC / (N+1)
- o TTx_sub-frame = (TTxMAC - TTxsh) / N
- o TRx_sub-frame = TRxMAC / (N+1)
- o TRx_sub-frame = (TRxMAC – TRxsh) / N

for type 2:
- o TTx_sub-frame = TTxMAC / N
- o TRx_sub-frame = TRxMAC / N

for type 3:
- o TTx_sub-frame = TTxMAC / 2
- o TTx_sub-frame = TTxMAC - TTxsh
- o TRx_sub-frame = TRxMAC / 2
- o TRx_sub-frame = TRxMAC - TRxsh
- o repetition interval = N*TMAC,

It must be inferred from the three distinct sub-framing schemes that they cannot coexist within a single network.

Sub-framing Schemes and Occam's Razor

Occam's Razor states that one should not increase, beyond what is necessary, the number of entities required to explain anything. Translated to Part 16, that would imply type 2 sub-frames. However, it becomes evident further into Part 16 in the sections regarding Community Entry of New BS, Network and Community Entry for SS, and the respective ensuing texts that these processes beg the questions of the identity of the arbitrator managing the regional database as well as the status of a given SS.

To appreciate the remainder of these comments on Part 16, the following sections have been excerpted and followed by the comments.

> **Coexistence Time Slot**
> *CTS (Coexistence Time Slot): a predefined time slot for the coexistence protocol signaling purpose, especially for the initializing BS to contact its neighbor operating BS through the SS in the common coverage area.*
>
> *CTS must not be used for other purpose by all the BSs, so that it will be an interference free slot for the neighbor discovery purpose. Initializing BS (IBS) shall use this slot to broadcast its IP identifier, so that the neighbor operating BS (OBS) could find the new neighbor in IP network after the SS report the message. Then the IBS and OBS begin further negotiation for coexistence protocol.*
>
> **2.1.3 Community Entry of new BS**
> *Figure11 explains how one new entry BS discovers its neighbor BSs. The new entry BS-5 uses its GPS coordinates (x5, y5) and its maximum coverage radius in LOS, Rm, at allowed maximum transmission power. A BS is neighbor BS of another BS if:*
>
> *- In co-channel operation the LOS maximum coverage area resulting for the allowed maximum transmission power overlaps one with each other. As depicted in Figure11, the regional LE DB will return BS-1, BS-2 and BS-3 as the neighbor BSs of the new entry BS.*
>
> - *in first or alternate adjacent channels operation, the BS should consider the attenuation of the transmitted power, corresponding to the actual operation channels of different Base Stations Once a LE BS has learnt its neighbor topology from the regional LE DB, it evaluates the coexisting LE BSs and identifies which BSs might create interferences. The Adaptive Channel selection will select the actual operating frequency, such that the probability of interference will be minimized. Each LE BS tries to form its own community. By including the neighbor BSs that might create interferences to the associated SSs The members of community will change when the working frequency of any BSs changes or new interfering neighbor BS comes in.*

The first phase of Community Entry

Whether by a BS or a SS, Part 16, 2.1.3 states that the "process uses the country/region (FCC) data base:" This begs the serious question of who owns and operates the database. The parenthetical inclusion of the FCC indicates a fundamental lack of understanding of the mission and role of the FCC. It should be evident from a careful reading of Part 15 that the FCC will have as little as possible to do with the regulation of license-exempt spectrum. Who, then, will own and operate the database? Part 16 takes for granted without regard to detail the politics and funding of a database manager.

"Operational dynamic changes" and "Interference victims and sources" have been excerpted below in these comments on Part 16 to demonstrate how they are dependent on the politics of arbitrating the dispensing of time slots within a license-exempt RF neighborhood.

2.1.6 1 Operational dynamic changes

2.1.7 Creation of a new sub-frame

If none (sic) sub-frame can be used, a new Base Station may request the addition of another sub-frame. The effect of such a request will be the reduction of operating time for those Base Stations that interfere with the new Base Station. However, all the others, that do not interfere one with each other and with the new one, may work in parallel and use the same operating time.

A Base Station will request the creation of a new sub-frame by:

- *Sending IP messages to all BS members of the community, and indicating:*
  - *o The interfering operator ID and BS ID*
  - *o The MAC frame-number in which the addition of a new sub-frame will take place.*

- *All the requested BSs will acknowledge the request, by*
  - *o Sending back a message having as parameters:*
    - *Frame-number for the change (must be the same as the requested one*
    - *Master sub-frame number for the new BS (SF = Sfold+1).*
  - *o If are missing acknowledges, those BS will be asked again, for another M attempts, after that will be considered that they are not working;*
  - *o At the above specified MAC frame number, a new sub-frame partition will take place, by inserting in the sub-frame calculation relation:*
    - *N=N+1*
  - *o The BSs will up-date the own SSs about the change*

- *Start to use the created Master sub-frame.*

3.1 Identification of the interference situations

3.1.1 Interferer identification

The interferers will be identified by their radio signature, for example a short preamble for OFDM/OFDMA cases. The radio signatures consist of:
- *Peak power*
- *Relative spectral density*
- *Direction of arrival.*

Every transmitter will send the radio signature during an interference-free slot. The time position of this slot (frame_number, sub-frame, time-shift) will be used for identification.
The transmitted power of non-interfering radio transmitters using a Master sub-frame will be known from the BS data base, indicating their power attenuation relative to the radio signature, for every used sub26 frame.

Priority and Preemption in Resource Allocation

The single most important issue that transcends the draft of Part 16 regards the policies/criteria by which BSs and by which SSs get how much time slice.

Part 16 is silent on attendant matters such as the:

1) status of the operator
2) number of BSs
3) status of the SSs
4) number of SSs

To highlight some of the issues that these four questions raise, consider the following. Who should have more priority over resource allocation (duration of time slot), commercial operators, municipal operators, emergency management services, law enforcement agencies, Homeland Security? Or, should all operators regardless of status equally share the resources.

What if two commercial operators have overlapping RF neighborhoods and one has ten times the number of SSs (and presumably ten times the BSs) than the other. How should resources be allocated as a function of the number of SSs and BSs?

What provision is there to dynamically reallocate resources on emergency ad-hoc criteria? Can the Department of Homeland Security preempt all other usage of a neighborhood network?

Then there will be "rogue" networks (probably comprised primarily of 802.11 protocols and the CSMA/CA contention-based protocol). 802.11 networks will continue to lack regard for the Part 16 database-generated rules for allocation of resources. How will rogue networks be not only identified but disciplined, given that the air waves are a public good and given that the FCC has a well established hands-off policy with respect to license-exempt spectrum?