Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Requirements for Broadband Wireless Access systems in the UNII bands**
Date Submitted	**2000-04-27**
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Re:	Call for Contributions: requirements for WirelessHUMAN systems, dated 4/12/2000, doc. 802.16h-00/02
Abstract	Some of the special requirements of the UNII bands are discussed, as well as reasons why the 802.11 MAC and PHY may not be the best choice for WirelessHUMAN systems.
Purpose	Intended as a starting point for discussion in the study group
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Requirements for Broadband Wireless Access systems in the UNII bands

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Introduction

This contribution partially addresses some of the questions raised in the 'Call for Contibutions' on Requirements for WirelessHUMAN systems, in particluar the following questions:

1. What are the applications for WirelessHUMAN systems?
2. What are the unique system design issues/requirements of WirelessHUMAN systems from a MAC/PHY layer perspective?
   -Is an 802.16-like MAC appropriate?If not,then why not?
   -Is an 802.11-like MAC appropriate?If not,then why not?
   -Is an 802.16.3-like PHY appropriate?If not,then why not?
   -Is an 802.11a-like PHY appropriate?If not,then why not?
   -What are the similarities with 802.15?
   -When should we try to apply for a PAR for WirelessHUMAN systems?

Applications

One application of WirelessHUMAN systems is in providing broadband wireless access to the Internet, as well as Internet telephony, for homes and small businesses. With the shortage of available licensed bands relative to the projected demand for wireless broadband access, it makes sense for operators to turn to the unlicensed bands instead of, or in addition to, the MMDS, PCS and other licensed bands. The savings resulting from not having to pay for spectrum can be passed on to the end user, which is clearly important for home and small business use.

Unique Design Issues/Requirements for WirelessHUMAN systems

1. Because the bands are unlicensed, the chosen PHY layer design must be robust against interference; while this is true for all systems, licensed bands have techniques for coordination, which don't apply here.
2. Because of the lower bandwiths available in this band compared to the LMDS bands, it is likely that most HUMAN systems will be used to serve homes and small businesses. Enterprise customers who need higher data rates, with less outage tolerance, will likely be served by the LMDS licensed bands. Systems for consumer and small business use require a PHY and MAC that can be implemented at low cost.

802.11 like MAC:

This MAC was designed to meet the needs of wireless LANs, where large amounts of peer-to-peer data transfer, without necessarily going through the infrastructure, is needed. In fact, the MAC supports both ad-hoc and infrastructure based LANs, whereas the BWA topology does not require ad-hoc network support. Also, it was designed to meet the needs of mobile users, and roamers, and address the issue of hidden nodes, and to be compatible with a variety of PHY layers. None of these requirements are applicable to WirelessHUMAN systems, so the 802.11 MAC is not likely to be the best for our purposes. The typical coverage area for wireless LANs may be up to (500 ft^2) to (1,000 ft^2) which introduces roughly 500 to 1,000 nanosecond (ns) propagation delay. On the other hand, in BWA systems, where the range of operation is of the order of a few km, the delays are much larger. Delay is an important issue in the design of MACs. For instance, if the MAC has to operate precisely synchronously among a pair of communication nodes, allowing for too small a propagation delay can destroy

signal quality and thus limit coverage area.

802.16 MAC:

The 802.16.1 MAC is meant for higher data rate (enterprises) and much higher frequency operation, so it may not be directly usable, but some variant of it may be. Some of the requirements, eg the need to support ATM services, may not be relevant for the home and small office markets addressed by the HUMAN group. This study group should monitor the activities of the 802.16.3 group to look for synergies.

802.11a PHY:

Since 802.11a was designed for a mobile environment, with extremely large multipath compared to the relatively benign multipath environment for fixed access, it is worthwhile re-examining other (non-OFDM) physical layers to see whether a simpler standard can be obtained, especially given the cost issues for home and SOHO markets. In particluar, OFDM requires backoff of the power amplifier by as much as 10 dB in some cases, in order to accommodate the high peak-to-average ratio of the waveform, and this can lead to an increase in cost of $45-$70 per CPE.

802.16.3 PHY:

This study group should work closely with the 802.16.3 group to explore synergies in the PHY layers. Again, the main differences will spring from the greater need for interference rejection in the UNII bands and from the need for a very cost-effective implementation.

802.15 systems

Since 802.15 is focused on personal area networks, which are typically under 100m in coverage radius, there is very little similarity with their needs and those of WirelessHUMAN systems, which are several kilometers in coverage.

Time frame for PAR

The first step, which the current working sub group should address, is the unique set of requirements. If we can reach agreement on these by the end of the meeting, it may be possible to try to get the PAR approved in July; else it may have to wait until November.

Conclusions

Because WirelessHUMAN systems are likely to be used to provide low-cost Internet and telephony services to consumers and small businesses, it is important to develop a standard which is not overly complicated and expensive, rather than using an existing standard such as 802.11 or 802.15 or 802.16.1, all of which were derived for a different set of requirements. The first step in the process will be to agree upon the requirements and how they differ from those used by the 802.11 and the 802.16.1 study groups. In terms of timing, if this process of defining requirements can be completed in the current meeting, it may be possible to apply for a PAR by the July meeting.