IEEE P802.11
Wireless LANs

Draft Letter for 5 GHz Coexistence

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5.15GHz Worldwide

Introduction

There are major innovations and changes occurring in the wireless industry that have worldwide implications. Wireless is being accepted as the major direction and innovative technology required for Internet telephony. The Internet telephony step is really just the first step toward instant and constant access to information "at your fingertips." What is of even more value than Internet telephony, however, is the ability to do everything you do at the desk or the kitchen counter with a portable computing device. Bandwidth and reliability over wireless links has always been the biggest drawback to this possibility. The coming necessity of Internet connectivity will drive more bandwidth and more reliable content into the products that enable people to do whatever they do from wherever they are. The 5GHz (by 5GHz bands we mean the 5.15GHz UNII, Europe's 5.2 GHz HIPERLAN1 and HIPERLAN2, and Japan's 5.15GHz 100MHz) spectrum bands are the next major step in allowing this innovation to occur. Major political entities in the world have allocated these bands for use, but there is not a consensus on how they should be utilized worldwide. The IEEE 802 recommends that the 5GHz band is the next band that should be implemented worldwide and that it should be unlicensed and allocated by the World Radio Congress (WRC).

IEEE is an international organization

The IEEE is an international nonprofit organization of electrical engineers that sets standards for the electrical and telecommunications industries. IEEE has brought standardization to communications wiring and protocols in Ethernet (IEEE 802.3) and is presently working on standardizing a ten gigabit version of Ethernet. IEEE is also working on wireless communications standards and in 1997 published the IEEE 802.11 standard for wireless Local Area Networks (LANs). In September of 1999, a wireless LAN standard was published for the 5GHz spectrum called IEEE 802.11a. This standard is a wireless LAN standard and therefore is meant to be a wireless extension of the wired Ethernet LANs that have been implemented throughout the world. Unlike the wired communications industry, wireless frequencies are regulated by administrations throughout the world. In light of this regulation, international requirements are not addressed except by international entities like the UN and the WRC. The leap that the IEEE and many international companies would like to make is to move into a wireless regime in which international requirements are addressed and a conclusion or consensus reached as to use of license exempt 5GHz radios worldwide.

5GHz standard

The 5GHz IEEE standard was developed for the high bandwidth wireless requirements. Adding bandwidth to communications media has been a trademark of the IEEE in its history. The moves from 10Mbps Ethernet to 100Mbps Ethernet to 1Gbps Ethernet to 10Gbps Ethernet is an example of the tradition. As with the wired standards, the wireless standards also provide the protocols at the physical (PHY) and Medium Access Control (MAC) layers to enable the communications to occur. The 5GHz standard was foreseen as a requirement by high technology companies who need to deliver high bandwidth

applications to mobile and portable devices that increase the productivity of individuals in their work and play.

IEEE 802 interest in using 5GHz worldwide

IEEE 802, in addition to its members, has an interest in encouraging the growth and development of these high bandwidth applications and services in the 5GHz bands. In order to meet the requirement that these standards be available worldwide, the question of radio spectrum allocation is one that must be addressed. There is a precedent; the 2.4GHz worldwide allocation of unlicensed frequency that was provided in an international setting in 1990. This worldwide allocation of bandwidth for unlicensed use created innovation and growth beyond the wildest dreams of the individual countries proposing it in that timeframe. Today, 2.4GHz is widely used spectrum on a global scale. There are lessons to be learned from 902 MHz and the 2.4GHz experience. To summarize, unlicensed data communications are too far down the primacy ladder, and there is too little free spectrum for wideband high speed data transmission. In addition, many countries did not fully implement the unlicensed bands. There are countries that did not implement the full band and thereby have drastically reduced the usefulness of the band. Necessary provisions for license exempt data communications will be discussed in detail in the following paragraphs.

Arguments For License Exempt 5GHz Worldwide

This section of the document lays out the background of and the arguments for designating the 5GHz bands as unlicensed worldwide.

Major areas of the world have allocated 5GHz bands

To start off, there are four major areas of the world that have co-allocated license exempt 5GHz spectrum already. These spectra

are cooperative within each area, but not necessarily internationally. The four areas are: US, Canada, Europe, and Japan (soon).

US (and Canada) – UNII

In the US, the Unlicensed National Information Infrastructure (UNII) spectrum was allocated in 1997. This allocation of unlicensed frequencies was meant to allow innovation and use by the largest possible number of US citizens, including indoor LAN as well as rural and remote radio connectivity to alleviate the high cost of connecting its citizens to telecommunications via hardwire. The lower and middle bands are useful for short distance LAN applications. The upper band of the UNII designation permits a 4 Watt outdoor allocation to connect to remote schools, libraries, ranches and farms without the high cost of connecting them via wire.

Europe – HIPERLAN

In Europe in the early 1990s, the CEPT and the European Commission allocated spectrum for Wireless LAN connectivity called HIPERLAN1. The spectrum was co-allocated to this purpose in Europe, so the specification developed by the European Telecommunications Standards Institute (ETSI), did not require terrestrial coexistence and therefore was not designed to be tolerant of interference nor the presence of other radio devices in the same spectrum.

HIPERLAN2, on the other hand, was meant to be a broadband access method and, up until several months ago, did not have a spectrum allocation. Within the last three months, the CEPT announced that HIPERLAN2 would be allocated (5.25-5.35GHz and 5.47-5.725GHz) as the broadband allocation for Europe. So, the European spectrum allocation is even broader than the US spectrum.

Japan – 100MHz

Japan will soon also co-allocate the 5.15-5.25GHz band as an unlicensed band. They are in the midst of attempting to expand the band, as the US and Europe have already done.

5 GHz Frequency Allocation in Major Regions of the World

Our conclusion is that the 5GHz bands are already in a position to be co-allocated for unlicensed use worldwide. The subject needs to be brought in front of the US, Europe, and Japan radio agencies and proposed that they be unlicensed worldwide. The World Radio Conference (WRC) is the next step in moving toward recognition that these frequencies be advanced to the status of license exemptworldwide.

Cooperative Efforts by the Standards Organizations

In working on specifications for the same frequencies, ETSI and the IEEE have worked together to prepare for mutual use of the 5GHz bands. They have a common Physical Media Dependency (PMD) layer that is the radio and have chosen a common OFDM scheme that opens the possibility of software radios that can use the same PMD layer. Therefore some work has already gone into enabling radio manufacturers to travel across international borders, using software in the radio to enable a switch between the UNII and the HIPERLAN2 modes of operation.

Opening up the 5GHz bands as license exempt worldwide frequencies will enable the standards to further innovation and use of the band by citizens world wide.

License Exempt 2.4GHz band has been a phenomenal success

There is a precedent to open up the 5.15GHz bands to unlicensed use worldwide: the 2.4GHz worldwide band.

Junk band innovation

To its detriment, the 2.4GHz band has become known as a "junk" band in which there are countless devices with a myriad of technologies attempting to capture lots of markets. This has contributed to the reluctance by many to rely on a radio band that could be interfered with at any time by a baby monitor or garage door opener. However, in spite of the 2.4GHz band being designated as an Industrial, Scientific, and Medical (ISM) band with many non-communications applications such as microwave lighting and microwave ovens, the band has been very successful in surviving these interference onslaughts. The reason it does well is because packet data communications is adaptive and can fit in-between the interfering signals. This does not work well for real-time wideband information transfers.

Cordless telephones

Lots of cordless phones are now moving to the 2.4GHz band and, possibly they will move to the 5GHz bands as well. When they move to 5GHz will be a function of how fast the prices for the chip sets move down.

Baby monitors

Another example of an application that will move to whatever cheap unlicensed frequencies are available are baby monitors. There are so many applications like this that we can assume a continuing movement of these applications to any available unlicensed frequencies if they are allowed.

Too Narrow

The 2.4GHz band is too narrow to accomodate major high bandwith applications like video and interactive three dimension CAD drawings.

Innovation

On the positive side, unlicensed 2.4GHz has created enormous innovation. Any idea an entrepreneur comes up with has an outlet through use of unlicensed radio. Therefore, the innovation side of wireless has taken off because of the 2.4GHz band and there is no end in sight to that innovation.

Encourages economic growth

There have been entire industries started based on these unlicensed bands and many more are going to be proliferated with the advent of more and larger bandwidth unlicensed bands. This is encouraged by having economies-of-scale from frequencies being allocated worldwide rather than regionalized.

Having Common Unlicensed Bands Worldwide facilitates international travel

The world and its companies are becoming more international all the time. Boeing is an example of a company that manufactures aircraft tails in Australia and fuselage parts in Japan. The need to move communications capabilities seamlessly across borders becomes a major business driver for efficiency and innovation.

Promotes high bandwidth applications

Common unlicensed bands also allow the easy migration and movement of high bandwidth applications such as delivery of streaming video and interactive three dimensional CAD.

Facilitates innovation in frequency use

Boeing, for example, has a strategic goal to engineer, design, and build anywhere on earth. To accomplish this requires instant and adaptive communications anywhere. Historically, the use of unlicensed frequencies has led to innovative ways to get more high speed data throughput using the assigned and available unlicensed spectrum.

Technologies are moving toward new radio technologies

In addition to the existing technologies for radio use, like spread spectrum (FH and DS), there are more technologies coming that will challenge the traditional radio capabilities. This section describes some of those:

Pulse radio

The company Time-Domain Inc. has some patents and has advocated a move toward pulse radio. Basically, pulse is like radar in that information is sent out in pulses. In the case of pulse radio, each pulse encodes information and therefore is like a digital morse code. This technology operates in the noise floor and is purported to be non-interfering to traditional narrowband and broadband technologies.

Removing radio heterodyne complexity

Another technology that may prove to be a major driver in the development of new radio technology is the reduction of the electronics used in the radio front end (direct to baseband). This technology may reduce the overall cost of the radio and drive the radios into commodity pricing.

New technologies yet to come

With all these new technologies showing up, who knows what innovations will come out as the business opportunities present themselves to utilize the wider bandwidth.

Arguments against license exempt 5GHz worldwide

This band will interfere with the MSS services

The 5.15-5.25GHz band is currently co-allocated to MSS satellite services. There is currently an aggregate power limitation of 10Watts/MHz within the footprint of an MSS satellite. This limitation is currently in place in the US and the

ITU-R 8A/9B is currently considering this limitation to be implemented worldwide.

Unlicensing Frequencies turns them into junk bands

The argument that making the 5.15GHz frequencies unlicensed will turn them into junk bands will only come true if there are no limitations on the use of low bandwidth applications in the band. By simple exclusion of low bandwidth applications, which could easily be accommodated in other unlicensed bands, the 5.15GHz frequencies could be preserved for the applications that require high bandwidth.

National entities should control and protect their frequencies

When limitations are imposed that require a national or regional wireless frequency plan, the costs of radio technologies never go below the threshold which makes a technology a commodity. The economies of scale are maximized when they are worldwide.

Protective policies preserve industry for national and local entities

While it is true that such policies might protect an industry in the short term, in the long term, the industry will be passed by because of technology innovation and be hurt in the long run.

5GHz won't be the last potential worldwide candidate

Historically, the radio technologies have moved from crystal-based narrowband through spread spectrum to noise floor code division across more and more radio frequencies. The next generation of license exempt wireless will be some other band above 5GHz. This next generation will face the same worldwide candidacy issues that 5GHz faces. However, the technologies for the next several years are best served by the

5GHz frequencies and their uses and it is the most cost effective technology to implement today.

US and Europe – regulatory philosophies

There are competing, as well as somewhat complementary, philosophies within the US and European regulatory areas with regard to the approaches to unlicensed frequency allocation.

UNII in US

The philosophy in the US is that anyone can operate in the band as long as they meet some elementary radio parameters, such as power spectral density and out-of-band emissions. The regulatory agency in the US wants to encourage innovation and technological advances.

HIPERLAN in Europe

The philosophy in Europe is that there will be one interoperability standard and therefore there will not be competing radio interference.

IEEE Position

The need is to develop communications standards that foster coexistence and maximize the benefit to users of the spectrum. Coexistence requirements are necessary to assure that the 5GHz band is available for wideband, high data rate applications. On the other hand, the European approach should be relaxed somewhat and allow for other systems, based on consensus standards, to cooperate in the same frequency space. Other high bandwidth and high signaling rate consensus standards, such as IEEE 802.11 should be allowed. IEEE is continuing to pursue collaboration and cooperation talks with ETSI to reach such an agreement.

2.4GHz not really worldwide

The regulations for the 2.4GHz band are not consistent worldwide even though the spectrum segment is touted as a worldwide band. Some countries have reduced spectrum allocations, power levels, out-of-band requirements, and thereby cause protocol problems. This situation fosters the possibility that illegal radio operations can inadvertently occur without the knowledge of the users or of the countries involved. This situation should be ameliorated in the 5GHz worldwide frequency space.

Conclusion

License exempt 5GHz worldwide operation is possible

A 5GHz worldwide unlicensed allocation is possible and wanted by all. It can also be preserved as an appropriate spectrum for wideband applications with some coexistence criteria development.

License exempt spectrum promotes economic growth and innovation

The unlicensing of the 5.15GHz band worldwide will accomplish the same economic growth and innovation that unlicensed 2.4GHz worldwide spectrum has created. In addition, it will promote innovation in wideband high data rate applications and services.

International companies need worldwide license exempt frequencies to flourish

International companies need to be able to operate on the same frequencies worldwide without the problems of dealing with national regulatory issues.

US should support license exempt 5GHz worldwide

The US is in a position to support license exempt 5GHz worldwide and to show leadership in advocating the deployment of these frequencies worldwide. The IEEE, an international organization chartered in the US, has worldwide membership. The IEEE represents an international community and may be considered to be not-country-specific or national in nature. The US government, on the other hand, must represent the companies and individuals within its borders and, altruistically, must look to the mutual benefit of all its citizens. As the world becomes more international, this emphasis must extend to companies and individuals worldwide. Therefore, the support for such a worldwide allocation should be considered a priority.