

## OP ED

## One Reader's Opinion

## Alternative Options for Resolving HSMM Interference Issues

Many newspapers around the U.S. print a page entitled "Op-Ed." This usually runs opposite the editorial page; hence its name. Sometimes the name takes on a double meaning, when the author has a viewpoint opposite to the editor's. Its purpose is to give a writer an opportunity to express a view or propose an idea for discussion in a longer format than what is normally found in a letter to the editor. There are many views and ideas floating around in the world of VHF that are worth considering and discussing. Please note that the views expressed herein are those of the author and do not reflect the views of CQ VHF or its editorial staff.

—N6CL

Writing for myself, and not the ARRL High Speed Multimedia (HSMM) Working Group, I wish to respond to "Op Ed" in the Spring 2003 issue of CQ VHF regarding the 2.4-GHz band and the negative slant the piece gave to amateur radio spread-spectrum experiments on that band.

One of the flaws in the spring "Op Ed" was the author's omission of the fact that in the U.S. the unlicensed FCC Part 15 IEEE 802.11b devices have access to channel 1 through channel 11.

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However, the U.S. amateur radio 2.4-GHz band shares only channels 1 through 6 of that Part 15 service. Therefore, any Part 15 wireless local area network, or WLAN, station experiencing interference from an amateur station of any type needs merely to change its operating channel to one of those *outside* the amateur band.

On the other hand, it must be noted that FCC regulations clearly require that any Part 15 user who is causing harmful interference to an amateur station must either cease operations, or correct the interference problem no matter how prestigious or wealthy the manufacturer of his or her equipment might be. That is the law.

Recently, current FCC rulings confirmed this requirement when two unlicensed Part 15 cordless-phone-device, not WLAN, users were directed by the FCC to either cease operating or eliminate the sources of the interference to a licensed amateur radio station using the AMSAT-OSCAR 40 satellite downlink. At last report, the unlicensed Part 15 equipment owners had a friendly relationship with the amateur radio operator, and the Part 15 owners were working with the equipment manufacturer to correct the interference problem. Again, that is the law and that is the way it is being enforced.

In like manner, any unlicensed WLAN Part 15 station experiencing interference from a licensed amateur high-speed multi-



On the left is the Logitech USB 1.1 Notebook Pro camera and its carrying case (for information see <<http://www.logitech.com>>). The large golf-ball camera on the right is the Orange Micro iBOT2, a USB 2.0 version of Logitech's iBOT firewire camera (for details see <<http://www.orangemicro.com>>). (Photo courtesy AH7R)

media (HSMM) station must accept such interference. It should be pointed out, however, that to date there has not been a single such report, so let's get real. Even if every active amateur radio station in the U.S. were equipped with HSMM, it is doubtful there are sufficient numbers of us licensed amateurs to cause any problem for the millions of Part 15 WLAN users.

Probably the most obvious reason for this lack of QRM is that the vast majority (but not all) of the unlicensed Part 15 users, both commercial and home-office WLAN, are located indoors and are using low, vertically polarized rubber-duck antennas. On the other hand, all amateur HSMM station antennas are outdoors and most use horizontally polarized, usually highly directional antennas up relatively high. These are much different RF environments.

Nonetheless, once again, the unlicensed Part 15 station has a simple solution if the amateur next door is using HSMM. Go to one of the channels outside the amateur band!

Let's look at a rundown of all the unlicensed WLAN channels. Keep in mind these are 5-MHz-wide channels, and the primary signal of an IEEE 802.11b device

is 22 MHz wide, so there is overlap, and again, only channels 1 through 6 are within the U.S. amateur radio 2.4-GHz band.

**1. Channel 1:** All stations, both Part 15 and Part 97, have always been asked by the ARRL HSMM Working Group to avoid operating on channel 1. Operating here may cause harmful interference to the licensed users of the AMSAT-OSCAR 40 satellite downlink. Many unlicensed Part 15 owners, including a number of wireless internet service providers (WISP), have honored this request, so there is a growing consensus to totally avoid the use of channel 1.

**2. Channels 2-5:** Amateurs are experimenting (albeit on a relatively small scale at present) on channels 2 through 5, so this probably is not the best RF terrain on which to park your office or home unlicensed Part 15 WLAN equipment either. You just might cause a problem to a licensed Part 97 user of the band. It's not a likely situation, but prudent practice is to avoid the possibility if you are an unlicensed Part 15 equipment owner.

**3. Channel 6:** Both home users and commercial WLAN users are starting to see the advantage of keeping their wireless equipment low-profile for security

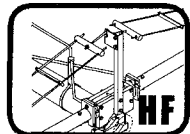
reasons. Thus, it would be wise to completely avoid the most common WLAN default, *right-out-of-the-box channel 6*. Amateurs are encouraged to avoid this channel, too, because that is where the bulk (70%?) of all Part 15 traffic is located, according to several aerial RF surveys. Therefore, avoid the QRM and stay off channel 6, even though it is legal for amateurs to operate there. Finally, what knowledgeable WLAN owner would want to set up his or her home or commercial office WLAN on that default channel 6 anyway? It would be similar to expecting privacy while playing checkers next to the freeway (hi).

**4. Channels 7-11:** The choice is obvious and simple for the owner of unlicensed 2.4-GHz equipment. Put the unlicensed Part 15 devices on one of the channels from 7 through 11, which have center frequencies totally outside the amateur band. Commercial WLAN users are starting to see the advantage of this approach. At least one major WiFi vendor is now recommending to all their customers to stay completely off channels 1-6 for all the reasons stated above. Also, they recommend they keep their unlicensed WLAN equipment, antennas, and coverage specific,

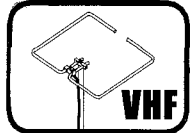
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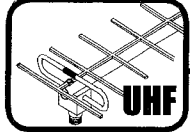
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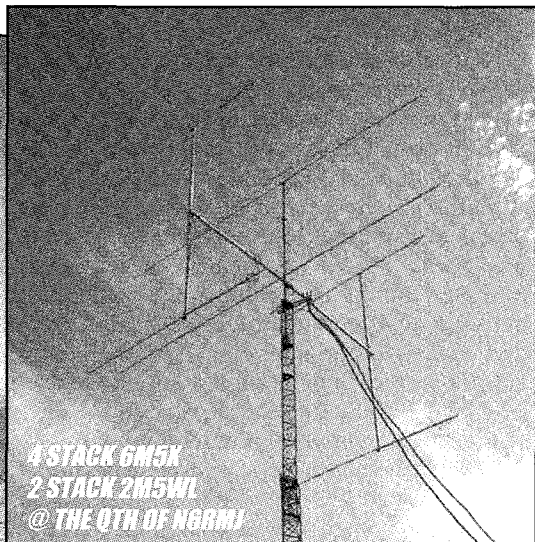


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modest, and low profile for the best security. They further recommend to all their customers that WLAN access points or hubs be linked together using a wired virtual LAN (VLAN). This, we are told, is a more secure configuration than the earlier methods of using commercial WLAN cells with adjacent non-overlapping channels that take up the entire Part 15 band by spreading out the WLAN channels over 1, 6, and 11, as was previously the customary practice. This is now considered a risky and outdated configuration for reasons of business security, we are told.

Finally, and as the ARRL has preached for decades, just because an amateur station has the legal right to run high power does not mean that it should run high power. Sound operating practice clearly indicates, and always has, that all stations use only the minimum power output necessary to maintain the communications link. This has always been the rule, regardless of whether it is an FM repeater or an HSMM access point. To suggest that anything other than this is being proposed is simply in error and a misreading. The intent of the HSMM materials has always been to encourage amateurs to experiment with spread spectrum, and to provide Part 15 equipment experimenters with a friendly welcome to the ranks of the licensed Amateur Service and/or membership in the League.

Yes, amateurs of all license classes are encouraged to get on the air; to get in on the fun and easy low-cost, spread-spectrum experimentation, and join the HSMM activity on the 2.4-GHz band. It's as simple as 1, 2, 3:

1. Go to your local Radio Shack®, Best Buy®, or other consumer electronics outlet and purchase some economical and readily available WLAN, also called WiFi, equipment. Just make certain it states that it complies with IEEE 802.11b. This is normally the cheapest choice anyway, because it is slowly being replaced by the newer 802.11g equipment. If you use a laptop in your station, get the PCMCIA card style. If you have a PC, get the WLAN-adaptor type that plugs into the USB port. This is the heart of your new station. It is a computer-operated HSMM 2.4-GHz transceiver, and it probably will set you back about \$60 to \$80.

2. Make certain the antenna(s) are removable and/or there is an external antenna port. If the device comes with a rubber-duck, or other little detachable antenna, remove it and throw it in the junk box. You won't need that.

3. Go to any issue of *CQ* magazine and look up Nema1 Electronics®, CableXperts®, or other cable source and order an 18–24-inch strain-relief cable, also called a pigtail, of the type needed for your WLAN card or device. It will probably cost less than \$20. It will have a strange-looking Part 15 type antenna connector at one end and a normal N-series connector at the other. Load the software on your PC and set it to any channel between 2 and 5 (they're in the amateur band). Hook up any external 2.4-GHz antenna (homebrew half-wave dipoles built on an N-connector are really cute...hi), or you can buy an Andrews 24-dBi dish antenna for as little as \$95. Shop around where the AMSAT-OSCAR 40 guys buy their Mode-S antennas. The antenna coaxial cable will likely be the most expensive part of the entire station, as you will want to use the lowest loss type you can handle. That's all there is to it. You may not have spent more than \$100 so far, depending on what antenna hardware you have around.

For operating software, most amateurs are using Microsoft® NetMeeting collaborative software, also called groupware, which comes free with the Microsoft Windows® operating system. They first go into chat mode much as in packet radio. Later they will add a headset to their sound card and start using streaming audio for normal voice contacts. Still others will add small, inexpensive web cams and operate another new multimedia mode, amateur digital video (ADV). This video is currently of somewhat less quality than amateur television (ATV), but it does provide acceptable full-motion color video suitable for two-way amateur communications (see photo).

Depending on how close your ham buddy is to your location, how high and clear your antennas are, the quality of the coaxial cable you are using, and a zillion other factors, you should be able to get several miles range. Remember, these HSMM devices are truly QRP and run only about 30–100 mw of RF output, so be resourceful and experiment often with different antennas, etc.

If your signals are not covering the path between you and the nearest other HSMM station, then open a copy of any edition of the *ARRL Handbook* and read the sections on antennas, transmission lines, and UHF propagation. Consider putting the antennas up higher, getting or building higher gain antennas, using lower-loss coaxial cable, etc., until the link is achieved. You

may also find a way to mount your gear at the antenna and avoid the expense and loss of coaxial cable.

Running higher power is an expensive last resort, but all amateurs should already know that, right? It's the sound operating practice, preached by the ARRL for decades, of running the minimum power needed to maintain communications, and it also is just good, old-fashioned common sense. Moreover, running the lowest possible power is glaringly obvious in the case of HSMM gear, because the RF power amplifiers (called BDAs, for bi-directional amplifiers) are relatively expensive. A good 1-watt BDA for IEEE 802.11b can cost as much as \$500, which is perhaps quadruple what you just paid for simple steps 1, 2, and 3 above.

IEEE 802.11b RF is spread spectrum, which means amateurs can operate using up to 100 watts of power. The FCC regulations provide that higher power limit because the government expects licensed amateurs to explore the full capabilities of this mode, not just set up little wireless household devices or appliances connected to a PC and a printer a few feet away. Again, just because you can run that much power on HSMM, doesn't mean you should. Be considerate of others who may be using the band, both amateur and non-amateur. Use only the power needed for the link. Got that?

We also need to consider several acceptable methods for separating Part 15 from Part 97 traffic on 2.4 GHz. It should be noted, however, that at least so far we have not encountered Part 15 traffic mixing or even QRMing our test HSMM networks, nor us QRMing them, to the best of our knowledge. This is despite the fact that our main HSMM test network ("The Hinternet") in Livingston County, Michigan resides directly in the middle of a major commercial wireless internet service provider (WISP) operation (MediaNet, Inc.). Oh well. So much for the "New CB Band Theory" (hi).

Please note that cooperation, coordination, and knowledge sharing (and even amateur radio and League membership recruiting...hi) are encouraged when you encounter the wireless LAN community organizations and the WISPs that may be in your area. Although we are licensed and they are not, they outnumber us many times over, so we should practice a live and let live in good harmony approach. Because of the content restrictions of the Amateur Service (no pornography, no commercial activity, etc.), they may not

wish to join us, but that doesn't mean we can't get along.

A traffic separation technique that is considered acceptable involves the use of WEP (wired equivalent protection)...not for encryption, as that may be inappropriate in the Amateur Radio Service, but for authentication. If you use this approach under Part 97, therefore, you should ask that the WEP key be published on the HSMM webpage, <[www.arrl.org/hsmm/](http://www.arrl.org/hsmm/)>. As an alternative, you could use your local radio club webpage to publish the key. Again, the WEP is used to avoid the accidental mixing of Part 15 and Part 97 traffic. Another approach gaining in popularity with many HSMM stations is the use of 44 domain IP addresses which are only available to the Amateur Radio Service.

This is all just the beginning. Did the previous "Op Ed" writer think that the only thing amateurs would be doing with this technology is the same as some WISP have done—i.e., just replace rubber ducks with outside antennas, thus changing the RF footprint from a WLAN to a wireless wide-area network? Amateurs are much more innovative and creative than that. No, these are just our first few baby steps into this spread-spectrum domain pioneered many years ago by the

Tucson Amateur Packet Radio (TAPR) group. It's just that now we have access to cheap, off-the-shelf gear that can be modified for the Amateur Service so we can learn, experiment, grow, and change.

Here is some of both my short- and long-range vision for HSMM:

The previous "Op-Ed" writer may not be aware of HSMM Working Group collaboration with TAPR to develop transverters suitable for use with 802.11b gear. These transverters would take the 2.4–2.5-GHz frequencies to the 3.3–3.5-GHz amateur band where there isn't Part 15 traffic at all, but the propagation is similar to that for 2.4 GHz. Also, HSMM is cooperating with AMSAT-NA and its proposal to experiment with ground-based 5-GHz in-band transponders.

There are other avenues of investigation that may also yield positive results in terms of the eventual development of an HSMM Backbone Network, or "Hinternet," for the amateur service—the use of HF and VHF (50.6–50.8 MHz) frequencies!

Accordingly, the HSMM Working Group is kicking-off a major research project called The HSMM-HF Project. Neil Sablatzky, K8IT (<[k8it@arrl.net](mailto:k8it@arrl.net)>), has enthusiastically agreed to lead this new HSMM project. Neil was part of

the original Hinternet Team. He built the first very large 2.4-GHz slot antennas for use in early amateur radio 802.11b experiments (see the "HSMM" column in this issue of CQ VHF for more details on simple, inexpensive 2.4-GHz horizontally polarized slot antennas—ed.).

Some of this new HSMM-HF Project is based on what we have learned about propagation using IEEE 802.11g. This "g" version is also on 2.4 GHz, but uses a non-spread-spectrum approach which is predominately orthogonal frequency division multiplexing. This is a modulation scheme.... Think of it as large string of PSK-31 signals. The HSMM Working Group has found that OFDM is more resistant to the adverse effects of multipath fading than spread spectrum. The plan is to use Gerry Youngblood's software-defined radios, Model SDR-1000, as the test platform for this project. See <[www.flex-radio.com](http://www.flex-radio.com)> for details.

Just because the "rest of the world" is using some off-the-shelf wireless gear for WLAN, and amateurs are adapting this same gear to their style of operating, does not mean by any stretch that this is what amateurs are always and forever going to be doing. We are just getting started with our explorations!

Wy 73, John, K8OCL

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