DOC. #23A

Report to the ARRL Board of Directors
John Champa, K8OCL
ARRL Chairman
High Speed Multimedia Networks Working Group
Technology Task Force
January 18, 2005

Executive Summary

It has been another exciting and productive time for the HSMM Working Group since our last report to the Board. We have developed a specification for an HSMM Orthogonal Frequency Division Multiplexing (OFDM) Modem that will allow Radio Amateurs to have all –mode voice, text, data, and video (i.e., multimedia) high-speed digital communications on the VHF, UHF and SHF bands. We hope to begin alpha testing of our OFDM modem this year in at least four locations (Racine, San Antonio, Tampa, and Livingston County) using an ATV channel in the 70cm band operating in a digital "image mode" we call Amateur Digital Video (ADV).

The HSMM Working Group has also prepared two recommendations for Board consideration:

- A new all-digital license scheme to attract Internet-savvy technical individuals to ham radio, and
- A frequency bandwidth plan that will allow for adequate digital development of Amateur Radio into the 21st Century.

Both of these recommendations are included in this report.

OFDM Modem

The 70 cm band is ideal for HSMM and, using the following interpretation of FCC regulations, we should be able to use OFDM modems with an occupied bandwidth up to 9 MHz (at least) on the 70 cm band. HSMM would be classified as an image emission type. This interpretation also allows 6 kHz (or more) bandwidth OFDM modems on the MF and HF amateur bands.

In 47 CFR 97.315 the emission type "image" is defined as including "emissions having B as the first symbol; 7, 8 or 9 as the second symbol; W as the third symbol".

In 47 CFR 2.201 (c) (2) a first symbol of B defines the type of modulation of the main carrier as an "emission in which the main carrier is amplitude-modulated (including cases where sub-carriers are angle-modulated) with independent sidebands". The OFDM modem fits this description as it has a central carrier with multiple subcarriers in the upper and lower sidebands that are angle (phase) modulated. In 47 CFR 2.201 (d) (5) a second symbol of 7 indicates that the nature of the signals modulating the main carrier

are "two or more channels containing quantitized or digital information". 47 CFR 2.201 (d)(2) and (3) indicate that time-division multiplex is excluded for a single channel so the time division multiplex inherent in HSMM communications creates two or more channels. In 47 CFR 2.201 (e) (8) a third symbol of W indicates that the type of information to be transmitted is "a combination of the above" and that includes (4) "facsimile", (5) "data transmission, telemetry and telecommand", (6) "telephony" and (7) "television". HSMM fits this definition as it includes data, speech and image components.

In 47 CFR 97.305 "a station may transmit the following emission types on the frequencies indicated, as authorized to the control operator, subject to the standards specified in 97.307(f) of this part". The following table includes the "image" type for all bands and references 47 CFR 97.307 (f) (2) for the 160 m through 1.25 m bands but does not reference it for the 70 cm through 1 mm bands.

This is the only restriction on the image emission type and states that "the total bandwidth of an independent sideband emission (having B as the first symbol), or a multiplexed image and phone emission, shall not exceed that of a communications quality A3E emission". I can't find a definition for "communications quality" but it seems to be taken as 3 kHz on the MF and HF bands.

Thus OFDM modems using 6 kHz or less should be authorized on 225 MHz and below and OFDM modems with no bandwidth restriction on 420 MHz and above. If the emission must fit within the bandwidth used by existing analog image communication devices, that bandwidth would be 9 MHz for DSM AM ATV with a 4.5 MHz sound subcarrier.

The HSMM Working Group specifically requests that the ARRL legal counsel, Chris Imlay, review this plan.

Submitted by John Stevensen, KD6OZH, HSMM WG, and RMAN-UHF Project Leader.

Licensing Scheme Recommendation

Improving and Expanding Amateur Radio in the 21st Century

50 years ago, amateur radio service gave its licensees access to wireless voice communication services that were otherwise unobtainable and trained people for careers in industry. It should be doing the same for today's wireless communication but isn't. This is a proposal for a 21st century novice license oriented towards HSMM. It would change amateur radio somewhat, but would ensure its existence by attracting younger users and make it more relevant to today's technology. First, let me explain why new novice licenses are needed.

The current Amateur radio licensing system assumes that everyone wants HF

access and they proceed along an upgrade path to get it. License classes are hierarchical. However, there are several groups of users within the ARRL that have different interests. Some are interested in having the best HF station and contesting or chasing DX. Others are interested in weak signal communication using portable stations on the microwave bands. One large group is interested in personal communication and emergency communications with VHF and UHF repeaters. Another group is interested in digital communication using computers. The "one size fits all" arrangement does not serve any group well and creates unnecessary contention among groups.

If license classes were organized by area of interest and new hams just picked the licenses that fit their needs, each license could better fit the interests of each ham. Rather than acting as an unnecessary impediment that is shrinking the ranks of the hobby, licenses could encourage new growth. Licensing that fits user needs could be more restrictive for HF spectrum where the number of users that can be supported is small and become less restrictive as the frequencies go up and large numbers of users can be accommodated.

Many amateur HF users prefer the traditional form of FCC regulation with highly structured bands and a Morse code requirement for their portion of the spectrum. The existing license structure largely fits their needs. However, hams interested in buying HTs and using voice repeaters face a lot of examination requirements that are unnecessary for their purpose. They should have a simpler license where they learn how to set up a limited station and agree to certain operating procedures and frequency ranges. This would encourage new membership and build the pool of emergency communicators.

Hams who want to set up repeaters or do high-power weak-signal communication on the VHF and UHF bands require more knowledge as they will be setting up larger, more complex stations. The current license examination system with an exam that stresses design requirements and RF safety fits these needs. However, a new license class for HT users would benefit the radio clubs setting up and maintaining repeaters by providing more members.

Those interested in computers and digital communication are under-represented in amateur radio ranks. They are technophiles as we are, but the current system does not serve them well. This is disturbing, as digital communication is the future. In particular, amateur radio should encourage the participation of those interested in software as all electronic communication now depends upon it. There should be a license class where they agree to certain frequency ranges and non-interference provisions. This type of license would expand the use of new technology, make the learning experience of amateur radio more relevant to ham's personal lives, increase the use of our microwave bands and allow the development of and experimentation with new high-speed multi-media applications. It also assists us in supporting public safety, health and welfare agencies during times of emergency as the majority of the information that

must be communicated becomes digital.

This new license wouldn't be called a "novice" license (as that might discourage its use) but a "digital communication" license and would authorize use of the following frequency bands:

6 m band: 51.1-51.5 and 51.6-52 MHz
70 cm band: 420-426 MHz
9 cm band: 3300-3400 MHz
3 cm band: 10.0-10.2 GHz
4 mm band: 78-80 GHz

MINORITY REPORT: This clause was rejected: "The 33, 13 or 5 cm bands are not included as that would impact ISM users and create congestion and interference." Rationale: The Radio Amateur service should not cede frequencies to another service such as Part 15. The counter argument was why directly take on the commercial interest?

The frequencies were selected to avoid weak-signal and voice repeater segments. There would be no restrictions on emission type. Maximum emission bandwidths would be:

6 m band: 200 kHz
70 cm band: 2 MHz
9 cm band: 25 MHz
3 cm band: 50 MHz
4 mm band: 500 MHz

Maximum power levels would be 50 W on all bands and the license would be for personal use only. There would be no antenna gain restrictions. The licensed equipment must include energy-sensing and transmission-deferral logic to avoid
interference with existing services. The license examination is an agreement on
operating privileges and practices and a series of multiple-choice questions that is signed by the user and processed by either the FCC or ARRL before issuance of a call-sign.

The license restricts equipment to a digital interface to prevent the creation of another FRS or CB service and prevent competition with wireless telephone services. Holders of higher-level amateur licenses are permitted to design, construct, install, test, repair and operate equipment on these frequencies via their current licenses. Holders of this new license are permitted to install and operate equipment certified for compliance by its manufacturer or equipment assembled by them and certified by a higher-level amateur radio service licensee.

For the FCC, the existence of this new license would ease congestion on ISM

bands and encourage the development of new technology in the U.S. Hams get new technology and a new pool of users that will become interested in other aspects of ham radio. Packet radio and HSMM enthusiasts get the possibility of creating large, useful, networks and the ability to attract software developers. The general public gets a means of encouraging technical education, promoting volunteerism and improving public safety.

Band Plan Recommendation

The ARRL High Speed Multimedia Working Group is extremely concerned regarding the nature many of the current proposals for band plans. We think that most such proposals, as progressive as they may appear to be at this time, will ultimately, in the future, severely restrict the growth and development of Amateur Radio into the digital age of radio communications of the 21st Century.

Any change in FCC regulations will freeze band plans in stone for the Next 20 years. To allow for future development, the HSMM working group recommends that FCC regulations should be simplified with only a single maximum allowed emission bandwidth for each amateur band:

160m: 10 kHz
80m-10m: 20 kHz
6m-2m: 200 kHz
125cm+: within band

The ARRL can then issue band plans that create segments with lower emission bandwidths and these can change over time as different operating modes become popular. On the 160 through 10 meter bands, one band plan must cover the U.S. to prevent interference. Above 30 MHz, the band plans may be regional.

The 10 kHz bandwidth limit on 160 meters allows the use of DSB AM. Many amateurs are using converted AM broadcast transmitters that were designed for this bandwidth.

On HF, the 20 kHz bandwidth limitation aligns amateur standards with shortwave broadcasting standards. 20 kHz is the maximum bandwidth of DRM (Digital Radio Mondiale), the worldwide standard for digital audio broadcasting between 0.1 and 30 MHz. This is also the minimum bandwidth that would allow HSMM applications as defined by the ARRL Technology Task Force (56 KBPS minimum data rate).

One goal of the new HF allocations is to encourage development of new higher-speed digital modes and this can only be accomplished by giving

developers the flexibility of using wider bandwidths. This would allow sharing of the sub-band by numerous stations with bursty traffic and be more efficient than multiple lower speed connections. High-speed links will be invaluable during emergency situations by allowing very efficient simultaneous transfer of voice mail, email and facsimile traffic from the affected area to the outside world.

We understand that amateurs using the existing HF CW and phone bands want protection, and if the ARRL must reflect that we recommend 200 Hz statutory limits at the lower for CW and low-speed data, and 6 kHz statutory limits at the upper end of each band to allow existing SSB, ISB and DSB AM operation plus any other modes that fall within the bandwidth limitations. At a minimum, 20 kHz wide emissions should be allowed in the following segments:

3.58 - 3.725 MHz
7.035 - 7.125 MHz
14.065 - 14.15 MHz
21.08 - 21.2 MHz
29 - 29.7 MHz

In the VHF bands, a 200 kHz bandwidth limitation matches VHF audio broadcasting standards. The 100 kHz bandwidth limitation is too restrictive as it unnecessarily raises the cost of equipment by preventing the utilization of mass-produced technology. Inexpensive SAW and ceramic filters suitable for data radios in these bands have a 160-180 kHz bandwidth as this bandwidth is used for GSM phones and FM broadcasting. Existing equipment for 76.8 KBPS FSK data links sold in Europe by companies such as Symek utilize these bandwidths. They would be easily adaptable to VHF bands and encourage new digital applications. Newer equipment using OFDM could expand the data rate to 230.4 KBPS allowing low-resolution compressed video or high-resolution SSTV with frame transmission times of a few seconds. High-speed VHF data links would be invaluable for emergency communications in rural areas where commercial services don't exist and our VHF bands are under-utilized. High speed digital operation is also more efficient with wider bandwidths as more stations can share a common frequency.

If bandwidth limits are required above 148 MHz, we recommend 200 kHz to 225 MHz, 10 MHz to 1300 MHz (to allow continued use of DSB AM TV transmitters with 4.5 MHz sound subcarriers), 45 MHz to 5,925 MHz (to allow use of 802.x equipment) and no limit above 10,000 MHz. All emissions must be within the allocated amateur bands.

Activities

The HSMM Working Group has provided an ARRL Representative to the IEEE 802.22 Working Group: Gerry Creager, N5JXS, our HSMM WG Network Infrastructure Specialist.

NTX HSMM highlights for '04

Dallas based HSMM group created, merged into the North Texas Microwave Society and new Yahoo group set up. Group now contains 72 members.

10 HSMM presentations held at Hamcom in June '04 (Hamcom is a multi-day NTX regional event with a draw of about 4000 attendees). Particular thanks to Gerry Creager N5JXS, Joe Jurecka N5PYK and Brett Neilson KC7IIB.

Introduction to HSMM presentations given to the North Texas Microwave Society, Richardson Wireless Klub, Garland Amateur Radio Club. Thanks to Doug Kilgore KD5OUG.

HSMM deployments performed at the 2004 Wild Ride (a Richardson, TX area bike rally), Hamcom and the Plano Balloon Festival. Thanks in particular to Doug Kilgore KD5OUG, Tony Campbell W5ADC, Bob Kmak K5WO, Joe Jurecka N5PYK and Ken Peter KD5ZXG.

Ongoing activities include developing equipment resources, building up field deployable equipment and working on bridging and mesh networking techniques. Special view is given to Randy Dunning KC5QHH, elected councilman for the City of Garland. Randy has built up a fairly impressive set of equipment for use by the Garland RACES organization and is actively exploring interoperability opportunities with Garland's new city mesh network.

Thanks also to the NTX section manager Roy Rabey AD5KZ for his help in publicizing our activities.

Submitted by John Beadles, N5OOM.