TAPR at Hamvention

Hamvention is nearly here and TAPR will be present in full-force! The biggest ham radio convention of the year runs from May 19 to May 21 at the Greene County Fairgrounds in Xenia, Ohio and TAPR has plans to fill your Hamvention weekend.

TAPR Booths

TAPR's booths will be in Building 5 where we will show what we have been up to lately. You can visit our booths 9 AM to 5 PM on Friday and Saturday and 9 AM to 1 PM on Sunday.

TAPR is a community that provides leadership and resources to radio amateurs for the purpose of advancing the radio art.

Hamvention APRS Meet-Up

By Jason Rausch, K4APR

I'm setting up a Saturday evening meet-up at Dayton this year for the APRS/Packet folks. I see this as a replacement for the APRS Forum that we no longer have at the actual event.

If you're a developer (hardware, software, etc.), please come and feel free to talk a few minutes about what you're working on. (I'll have some of my hardware on hand to show off.)

My plan is to hold it Saturday, May 20, 6 PM at Little York Pizza & Tavern, 4120 Little York Rd., Dayton, OH 45414

If I can get a rough idea of how many might show up, I'll call them and give them heads up of our group.

Feel free to respond to me via e-mail me: jason (at) ke4nyv.com

###

TAPR Forum

Friday at 9:15 AM, Dave Larsen, KV0S, will moderate the TAPR Forum in Greene County Fairgrounds Forum Room 1. Speakers include Dylan Romero, KN6IVW, on his 3D-printed TangerineSDR enclosure, Michael Ossman, AE3H, on his Universal Radio Tester, and John Ackerman, N8UR, on his Something or Other.

TAPR/AMSAT Dinner

The 15th annual AMSAT/TAPR Banquet will be held at the Kohler Presidential Banquet Center on Friday, May 19 at 18:30 EDT.

The Kohler Presidential Banquet Center is located at 4548 Presidential Way, Kettering, Ohio – about 20 minutes away from the Greene County Fairgrounds. Visit www.amsat.org for more information and how to purchase tickets ($60 each) for the event. (Banquet tickets must be purchased in advance and will not be sold at the AMSAT or TAPR booths.)

The Gang

The folks behind the scenes at TAPR will be at Hamvention, so you will have an opportunity to say "Hello" and have an eyeball QSO with the TAPR gang.

###

HF radio control with a Contour Xpress Multimedia Controller Wheel

By Darryl Smith, VK2TDS

This is the first of a series of articles from Darryl talking about his experiences as a long time ham getting started with HF, and operating using a Mac rather than Windows or Linux.

I recently got into HF, after 30 having my license for 30 years, and being on the TAPR board for about 20. I felt the time was right to explore digital technologies below 144 MHz. A minor complication is that I am living between two houses - one just outside Sydney, and another about four hours south. Being able to use my radio despite the location would definitely be a bonus.

One of the deficiencies with remote operations was with the control of the rig. Sure, there are programs available for control, but they don't really provide a tactile interface for a remote rig. I wanted something that would be nice to use, but not be too expensive.

Browsing the WfView forums, I found the Contour Xpress (https://contourdesign.com/products/shuttle-xpress). At about US$60, the price was good. This device was connected via USB, has five buttons, a spring loaded 'shuttle' dial, and a jog wheel. The only issue was the software.

The software that comes with it allows you to program it so that buttons become custom key presses, and the dial will work some smart way with whatever software you are using. It will even change keystrokes depending on what program is being worked on.

My mode of working is that I want to be able to have the radio software working in the background whilst doing other things. Most USB Human Interface Devices (HID) such as keyboards and mice only operate either on the active window or the window that the pointer is over. That really didn't work with controlling a radio. So it was time for a project.

After a lot of work, I managed to write a software driver for the Contour Xpress that controls my Icom IC7300 regardless of which window is active. It would probably work with almost any HF radio, but that is the only one I have tested it on.

The device driver is actually not that complicated. Written in Python, it connects to the controller, and receives commands from it. Also, being in Python, the software should work on Windows and Linux as well as its native MacOS.

The next part of the project was more complicated. I found numerous issues with HamLib and the rigctld, at least under MacOS. Don't get me wrong, HamLib is great. But I experienced all sort of weird issues trying to use it with my Icom IC7300 radio. I could never trace the source, but at times, the software would not correct to the radio correctly. At other times, it just did weird things.

To be honest, I think some of the issues are MacOS related with regards to the serial port; possibly with multiple HamLib clients trying to simultaneously communicate with the radio strange behaviour. After mostly getting the software working with HamLib, I decided that it wasn't reliable enough and went looking for another option.

FlRig

Apart from HamLib, the other major interface definition out there comes with the 'Fldigi' series of open source software from W1HKJ. Getting FlRig operating was simple, and so was connecting WSJT-X to it. Alas, the interface to FlRig looked significantly more complex. Whereas HamLib used a fairly simple set of commands on top of a TCP connection, FlRig used XML-RPC. And XML-RPC was not something I really had any experience of.

Thankfully, there was a library that took all the pain away from interfacing with the 'Fl' line of software. Or so I thought. The library, pyFldigi, looks easy enough for me to use. Alas, it just didn't work. Some commands such as setting the frequency of the radio worked, but then querying the frequency wouldn't work. I worked trying to find a solution for hours and hours, getting nowhere.

Eventually, I decided to dump the library, and use a generic Python XML-RPC library. This worked a LOT better, but there were still strange issues with commands not working. This is when I made some discoveries. The first was that the pyFldigi library didn't seem to line up with Fldigi. For instance the pyFldigi tried to use a command 'rig.get_frequency', which

didn't work since Fldigi now uses 'main.get_frequency'. In essence, it appears that pyFldigo is a bit out of date.

The most important discovery however is that Flrig uses its own XML-RPC API that is a bit different from the one in Fldigi. It really should have been obvious since the API is described in the help in Flrig.

Once this confusion was removed, interfacing to the radio became simple. In fact, the interface to Flrig is much simpler than the interface was to HamLib. The great thing is that both these interfaces work over TCP, so they should operate with port forwarding or over a VPN

Commands

Currently all the commands are hard coded in software. They should be easy to change for anyone who knows Python. Having said that. I am hoping that the commands will be configured by a command line option or a GUI one day.

Right now, I have implemented are:

Jog Wheel: Change the VFO frequency

Shuffle Wheel: Unused

Button 1: PTT

Button 2: Unused
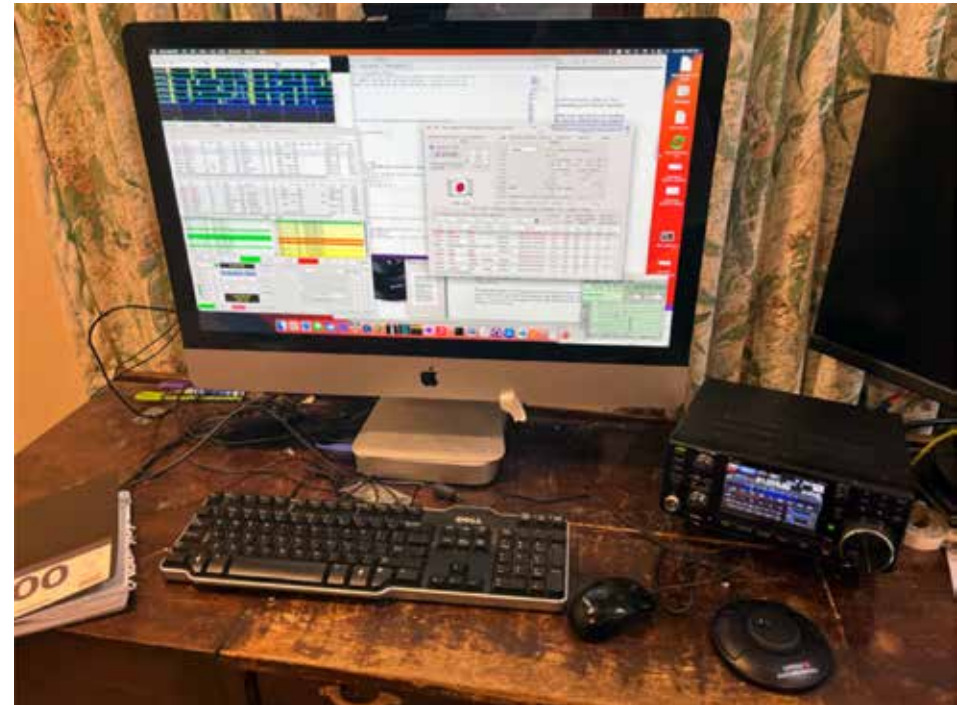
Button 3: Toggle between the minimum frequency change on the dial - it can be either 10 Hz or 1 kHz

Button 4: When pressed, it changes the Jog Wheel to adjust the Power Level

Button 5: When pressed, it changes the Jog Wheel to adjust the Microphone Gain

MacLoggerDX

I must say I do like the program MacLoggerDX I chose to do logging of QSO's. It does everything I want, and I was happy to pay for the cost of the licensed.. One thing that I have found is that it wont connect to Flrig directly. To be totally honest, this is a bit of a letdown. It will connect to radios directly, or to HamLib. Just not to Flrig. And this created a problem.

The connection to the radio is only needed for manually logging contacts where you want to automatically fill in the frequency, so I could live without it. Logging from applications like WSJT-X is sent to MacLoggerDX through a separate mechanism that worked regardless. In any case, I thought I would see what I could do.

Ironically enough, I ended up implementing an optional very basic HamLib compatible server in the driver software. It only implements the single command that MacLogegrDX needs in order to poll the details it needs from the radio.

Source Code

The source can be found on GitHub, and is definitely a work in progress. I am more than happy to accept updates, but I should warn you that I am not particularly good at using GIT. https://github.com/vk2tds/RigDial

###

Keurig in the Log

By Stana Horzepa, WA1LOU

I was surprised to find strong interference on the AM broadcast band between 550 and 1250 kHz, peaking at 20 over 9 on 860 kHz! I could only hear the strongest radio stations through the noise.

Maybe a neighbor acquired a new gadget that was spewing out the noise, so I grabbed a portable AM receiver, took it outdoors and walked around the perimeter of my little acre. All I heard were crickets. However, when I walked closer to my house, the noise came back, so I went back indoors and searched for the noise inside.

I checked all the usual suspects, but did not find the source. However, as I walked through the kitchen, the noise was very strong and I discovered the source: our new Keurig K-Cup coffee maker! Unplug the Keurig and the noise disappeared.

Our old Keurig(s) never caused radio interference, so I was disappointed that our new unit did. I called Keurig customer service, explained the problem and they put me on hold for about 10 minutes. When the service rep came back, she admitted that they did not have a troubleshooting procedure for my problem. They assumed that the unit was bad out of the box, so they are shipping me a new unit at no cost.

The replacement arrived and when I plugged it in, I discovered that the new Keurig's "transmitter" performed as well as the old Keurig's "transmitter."

The workaround – unplug the Keurig before I power up the radio.

###

ARDC News

By Dan Romanchik, KB5NU

FreeDV aims to bring open-source HF digital voice into the mainstream

ARDC grant will fund development, documentation, and promotion of this important open-source amateur radio technology

March 10, 2022—To advance the state of the art in HF digital voice and to promote its use, Amateur Radio Digital Communications (ARDC) has awarded $420,000 to the FreeDV Project. With this grant, the FreeDV Project team will:

• Hire experienced digital signal processing developers to work with the volunteer staff to improve speech quality and improve low signal-to-noise ratio operation, making FreeDV performance superior to single sideband (SSB) over poor high-frequency (HF) channels.

• Work with commercial HF radio companies to embed FreeDV into at least two commercial radios, greatly reducing set up effort and reducing latency.

• Continue development of a suite of advanced, open-source HF modems, with the goal of making FreeDV's digital performance comparable to VARA at both low and high signal-noise ratios.

• Continue support of the existing software library (libcodec2) and application software (freedv-gui), and embedded FreeDV adaptors (SM1000 and ezDV).

• Better promote FreeDV online and in person at amateur radio clubs and conventions.

The FreeDV Project team believes that the work funded by this grant will:

• Open the path to widespread adoption of a truly open-source, next generation digital voice system for HF radio.

• Provide a mature, open-source low-bit-rate codec useful for a variety of amateur radio and commercial applications.

• Provide a suite of high performance, HF data modems for open-source data applications usable by any radio amateur.

About FreeDV

FreeDV is a low-bit-rate digital voice mode for HF radio. Initially developed by David Rowe, VK5DGR, an international team of radio amateurs are now working together on the project. FreeDV is open-source software, released under the GNU Lesser Public License (LPGL) version 2.1. The modems and Codec 2 speech codec used in FreeDV are also open source.

Hardware and software developers can integrate FreeDV into their projects using the FreeDV API. To operate FreeDV, radio amateurs either run the FreeDV GUI application on Windows, Linux and OSX machines or use the SM1000 FreeDV adaptor. Either method allows hams to use a single-sideband HF radio to send and receive FreeDV signals. To learn more about FreeDV, go to https://www.freedv.org.

N2RJ Joins ARDC Board

On April 3, 2023, Ria Jairam, N2RJ, joined the board of directors of Amateur Radio Digital Communications (ARDC). Jairam has been a licensed amateur radio operator since 1997, after first having been licensed in her native Trinidad and Tobago. She has served on the boards of the American Radio Relay League (ARRL) and the ARRL Foundation. She is actively involved in amateur radio outreach and education through speaking at clubs and conventions, social media, her weekly radio show on WRMI shortwave radio and her YouTube channel. She holds a Bachelors of Science in Electrical Engineering (BSEE) from NYU Tandon School of Engineering, and currently works in software and systems development for the financial industry and design consulting for renewable energy and energy storage projects.

Jairam was inspired to join the ARDC board by former director, Bob McGwier, N4HY, who recommended her prior to his departure in December 2022. She notes, "[McGwier] once told me, 'You can change amateur radio forever with us.' After seeing what ARDC has done and is doing, I'm a believer. So I'm here to make that happen." Rosy Schechter, KJ7RYV, ARDC Executive Director, says of Jairam, "Ria is a powerful voice in amateur radio, and we are proud to have her join our team. She's definitely going to help us make great things happen."

About ARDC

Amateur Radio Digital Communications (ARDC) is a California-based foundation with roots in amateur radio and the technology of internet communication. The organization got its start by managing the AMPRNet address space, which is reserved for licensed amateur radio operators worldwide. Additionally, ARDC makes grants to projects and organizations that follow amateur radio's practice and tradition of technical experimentation in both amateur radio and digital communication science. Such experimentation has led to advances that benefit the general public, including the mobile phone and wireless internet technology. ARDC envisions a world where all such technology is available through open source hardware and software, and where anyone has the ability to innovate upon it. To learn more about ARDC, go to https://www.ampr.org .

###

Getting into HF with a Mac

By Darryl Smith, VK2TDS

I have been a ham for quite a while. I was first licensed back in 1993, getting my callsign in order to play packet radio. I ended up buying a TNC-2 PCB and EPROM from TAPR, buying the rest of the parts locally, and building the TNC myself. Getting the TNC running was surprisingly easy, and I don't remember having many issues with construction.

I bought an old generic 2M HT from a guy at work, using this to get myself onto packet. I also picked up an almost complete TNC-1 from the same guy, and ended up using it as part of my paper for the 1997 DCC in Baltimore. I loved the DCC experience and have lost count of how many I have been to. Living in Australia, visiting the DCC involves a long time in the air, and is not cheap. I joined TAPR back then and I have never left. On top of all this, I have been on the TAPR board since 2002.

Professionally, I am a self-employed consultant electrical engineer. Many of my work projects are radio based, often using my experience in ham radio to support my clients. I used APRS on commercial frequencies back in 2000 for the Sydney Olympics and for some consulting in Hollywood; and more recently I have been involved with cell site installations inside data centres and microwave video links for a big budget film.

So, why am I telling you all about this? Well, after being licensed for the better part of 30 years and recently turning 50, I have now decided for the first time ever to try out HF. I must say, my experience in HF has been somewhat limited. I saw David Bern do some digital HF portable in the Washington DC area when I visited the USA for the Tampa DCC back in ????, but I have had close to zero exposure to it before or since.

This whole experience with getting a HF radio set up has definitely been a learning curve, with lots of reading, and lots of playing.

The other thing you need to know about me is that I am a Mac user. I have been for a bit over 10 years, and rarely do I want to go back to Windows.

The Radio

Choosing my first HF radio was rather complex. Did I want something low power with a battery built in, good for portable use? Maybe even something I could use with APRS whilst out trail running. Or did I want something for use at home with a decent antenna? Did I want a brand name, or a generic Chinese device? Too many decisions.

In the end, I cheated and logged onto Twitter and asked a few of the hams there. The response I got was that the ICOM IC-

7300 was very good value, providing a reasonable bang-for-buck. It is Software Defined, with coverage of 6M in addition to the HF band.

The main downside compared to the more expensive Icom radios is that the radio has a USB connection but no network. Still, that was more of an excuse to buy another MacMini for the radio.

Mac Software

I have found the radio software available for the Mac is actually fairly good. There are some tools that are only available under windows, but in general, you can do most things you need to under MacOs.

The key programs I use at the moment are:-

• TSQL - Trusted SQL, with an interface to Logbook of The World.

• MacLoggerDX

• WSJT-X

• Flrig

• JT-Bridge

• HamClock

What I am finding is that I genuinely need (want) a second monitor for my HF work. Just using FT8, I generally have a few windows open (Flrig, MacLoggerDX, two for WSJT-X and JT-Bridge). I then also have windows open for other things I am working on, such as Safari for web browsing, e-mail and Microsoft OneNote. Too often I find myself being distracted from doing other things by wanting to see what is going on. I may end use an iPad as a second screen, but I just haven't worked that one out yet.

LoTW - Logbook of The World

One of the amazing things the ARRL has done is created an infrastructure for electronic confirmation of contacts. I find it frankly refreshing that the ARRL has put significant resources into not only developing but operating this infrastructure.

LoTW is generally used with the TQSL or Trusted QSL program to interface between the logging software and the LoTW back end. Thankfully, TQSL operates under Windows, MacOS and Linux.

The instructions for LoTW leave a bit to be desired; and to be honest, I feel like I have gone back 15-20 years in user interface design. LoTW seems to be built around PKI certificates.

Getting my LoTW account set up wasn't too bad, but it was a bit more complex than just signing up for a web site. The ARRL

wanted to see copies of my Ham license, as well as government issued ID, with redactions to reduce the chance of ID Theft. In return I got access to the LoTW web site and software to create my QSL signing certificate.

Rather than try to compete with providers of logbook software, the ARRL have created an infrastructure where third party software can upload their logs and download confirmations.

LoTW is different from places like eQSL in that it does not show entries where the other party has uploaded a QSO and you haven't. This stops the temptation of adding log entries for QSO's that didn't actually exist. LoTW also has checks and balances, ensuring that the grid square for your QTH selected in the logging software matches that in the LoTW back end.

The main problem I see with LoTW is that its use is not universal. I have seen reports from FT8 users suggesting that only 50-60% of FT8 users use LoTW to QSL. I am at 57%. Strangely enough, I just checked with eQSL, a competing site with less strict conditions and I am 57% there too, although it is a slightly different 57%

MacLoggerDX from DogParkSoftware

Being a Mac person, the availability of software is different from those running windows. Sure, I could install VMWare or Parallels (or a similar open source alternative), but I would rather stay with a native Mac application. After evaluating a number of options, I settled on MacLoggerDX *(figure below)*. This program isn't free, but I have found it well worth the money.

One of the features of logging software is looking up details about callsigns. That is, names, addresses, QSL information, e-mail addresses and the like. Some information is available for free, but not all of it.

I have subscribed to www.hamcall.net for $28 every six months, which gives me 1000 lookups per day. I have also subscribed to www.eQSL.cc for $12 for 12 months. www.qrz.com looked good, but at $35.95 per year, I didn't think the value was there.

I configured logs to be uploaded to LoTW, eQSL.CC and ClubLog. LoTW and ClubLog are certainly free for uploads. I think the $12 for eQSL.CC is for the ability for me to do automated uploads.

As you will see in my article about the Contour Xpress controller, I have configured MacLoggerDX to connect to a local HamLib server running on port 4532. This allows the software to automate the process of filling in details from the radio when doing QSO's that are not computer mediated.

WSJT-X

Getting WSJT-X *(figure above)* running was a slight pain. When I started trying to run it on my new M1 Mac Mini, I got a memory error, which stopped the program running in its tracks. After doing a heap of searching, I found the solution. There was a readme file with the program when it was installed that actually said what to do in this case. Who knew.

The other issue I had was with the version of WSJT-X that I was using. For some obscure reason, on some Mac's, version 2.5.4 had an issue with the Power slider. That is, the slider was backwards. But not the backwards you would expect. It was such that when you pulled the slider towards the top of the screen, it moved towards the bottom of the screen, and vice versa. This made it hard to work out what level I was actually transmitting at, and delayed making QSO's for several days.

The fix was to run the beta version of 2.6.0, where this problem was fixed. In retrospect, I should have picked up earlier that there was an issue. The radio would just produce a blue line on the waterfall when I was transmitting, rather than a yellow or red when I am transmitting with actual power.

Controlling the Radio

Thanks to HamLib, most Ham software seems to be able to interface to radios directly. This might sound like a wonderful thing, but I wanted to be able to be able to quickly move from FT8 to Fldigi to FreeDV and more. Whilst programs such as MacLoggerDX might have the ability to talk to the radio, they often don't share the radio to other applications.

The answer was an application that would interface to the radio, and serve the radio up to all the other applications. I found a great program called WfView that seemed to do exactly what I needed for Icom radios and a lot more. So I started using it, and connecting WSJT-X and MacLoggerDX to it.

I quickly found that strange things would happen. The first was that over time running FT8, the frequency on the radio would be off by 1-2 kHz. Secondly, PTT commands to the radio would go missing, leaving the radio not transmitting when it should, or not turning off when it should be receiving.

After a LOT of work, which included getting out Wireshark to look at network commands, I put in a bug report on the WfView forum. It turns out there is a known issue with some Icom radios with WfView, where serial commands are corrupted or go missing, likely due to some internal issues within WfView. Thankfully there was a simple solution.
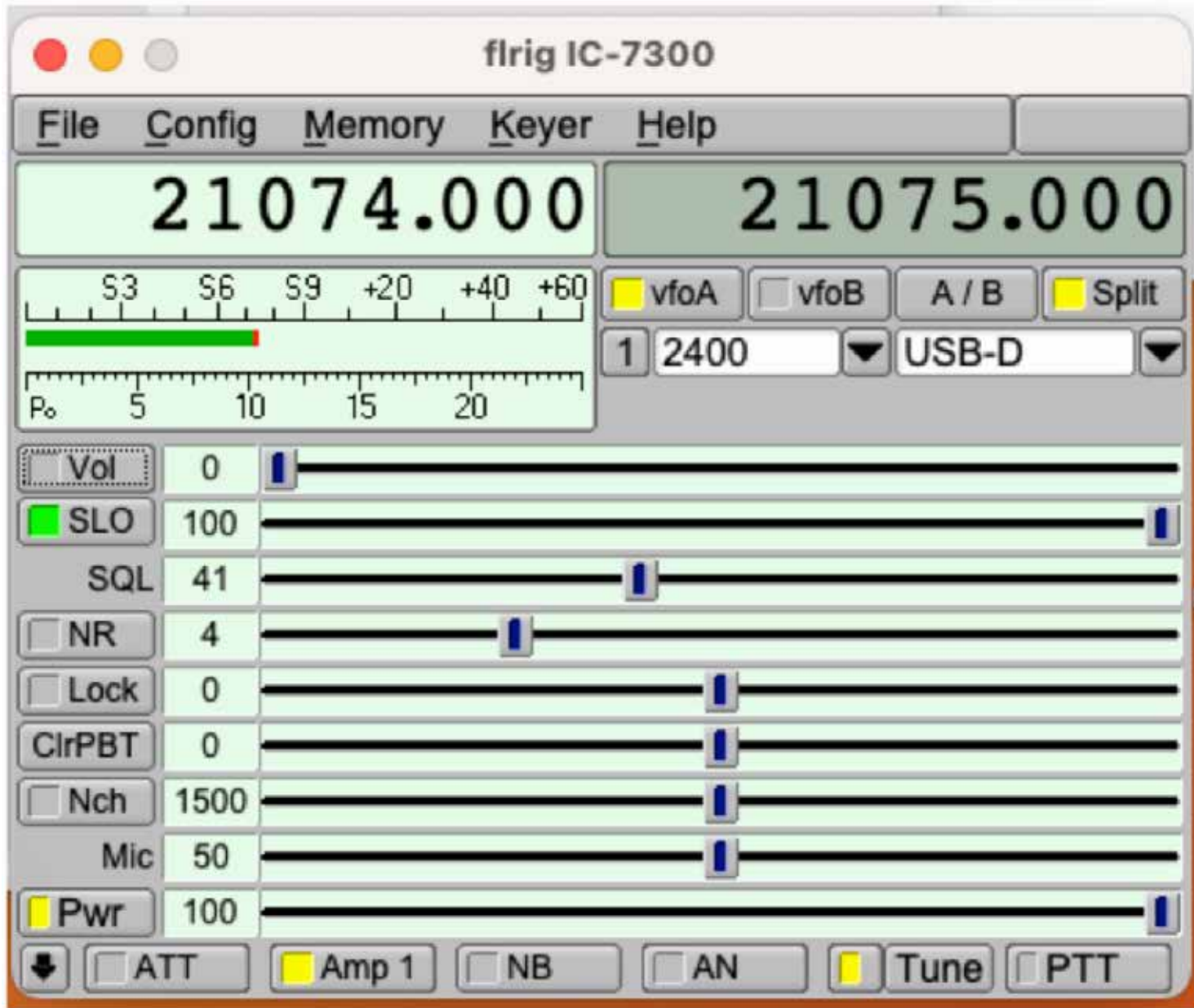
Flrig

Rather than deal with software that wouldn't work, I moved to the Flrig software *(figure above)*. It is part of the Fldigi suite, but is less well know. It seems to do almost everything that WfView does. The main caveat is that WfView is designed for remote operations of radios, and WfView only operates locally. Not to say that Flrig can't be made to operate remotely, but that is a separate issue.

JT-Bridge

Being that I use MacOS, the availability of software can be variable. Under windows there is apparently a nice program called JTalert. This program connects to the WSJT-X instance, letting you better manage FT8 operations.

There is a similar program for MacOS called JT-Bridge. This software provides a different view of FT8 traffic. Importantly, it provides a unified interface indicating which stations you have contacted before, and which stations you might need for an award such as DXCC.

As much as I like the program, it would be great if it could provide better audible alerts. I would love to be able to be able to get an audible alert under the following conditions for instance:

• Somebody is initiating a QSO with me

• There is a new DXCC or Zone etc, but only if the signal is over a certain limit

When I first started using this program I did notice that the interface to the logging application no longer worked, and silently failed.

Fixing this turned out to be a network issue. Normally you would have a point to point connection. With TCP/IP (or in our case, UDP/IP), you would use the address 127.0.0.1 to indicate that traffic was destined for this machine. But this is limited to two pieces of software.

To use more (in our case MacLoggerDX, WSJT-X and JT-Tunnel), we need to use a different addressing scheme. In our case, we need to use multi-cast to get the packets around the machine. Sounds complex, but it is fairly simple. Simply change the IP address you are connecting to from 127.0.0.1 to 224.0.0.1.

The complication here is that there is no user interface in MacLoggerDX to do this. Thankfully, it is available in a hidden setting. From the terminal, typing the following command will make the changes.

defaults write com.dogparksoftware.MacLoggerDX wsjtx_multicast_group "224.0.0.1"

With this change in place, restart all the software, and things

should be fine.

The Other WSJT-X Like Programs

I have found a few pieces of WSJT-X derived software out there running on MacOs.

- JS8Call
- JTDX

According to the JS8Call Web Site (http://js8call.com), 'JT8Call is a derivative of the WSJT-X application, restructured and redesigned for message passing using a custom FT8 modulation called JS8'. It is heavily inspired by Fldigi and FSQCall. It is called an experiment to test the feasibility of weak signal keyboard to keyboard messaging.

As for JTDX (https://sourceforge.net/projects/jtdx/), this is another fork of WSJT-X. Alas, I have not really been able to find a definitive list of how JTDX is different, but it appears that the decoding algorithm has been tweaked for better performance in poor signal conditions. I know that this might be a minor thing, but there are numerous references to a website (jtdx.tech) in documentation that no longer seems to be active.

HF Propagation

I have to admit that there is a LOT that I have forgotten about since I did my Ham license back in 1993. Even getting my license was done on a whim, organized whilst my parents were out of the country and I had access to a car. HF was never an interest at the time, and has rarely been since. One of the few times I have even thought about HF since then was when I was finishing uni, and was thinking of building a 'modern' HF radio for my Electrical Engineering thesis. I ended up working on half duplex spread spectrum networks instead.

Working JT8 has given me a much greater appreciation for propagation, and what bands are likely to be open when.

In the next part of this series, I will talk about adding Fldigi to the mix of programs I use.

###

Write Here!

Your *PSR* editor is working on the next issue of *PSR* and hopes to find a few good writers, particularly ham radio operators working on the digital side of our hobby, who would like to write about their activities and have them published here in *PSR*.

You don't have to be Hiram Percy Maxim to contribute to *PSR* and you don't have to use *Microsoft Word* to compose your thoughts.

Your *PSR* editor can handle just about any text and graphic format, so don't be afraid to submit whatever you have to wa1lou@tapr.org --- she can handle it!

The deadline for the next issue of *PSR* is July 1, so write early and write often.

###

On the Net

By Mark Thompson, WB9QZB

Facebook

As you may know, TAPR has a Facebook page, www.facebook.com/TAPRDigitalHam.

However, I also created a TAPR Facebook Group, www.facebook.com/groups/TAPRDigital/.

If you have a Facebook account, "Like" the TAPR Facebook page and join the TAPR Facebook Group.

If you join the group click on the Events link and indicate you're Going to the events.

On Twitter, Too

Access the TAPR Twitter account at

www.twitter.com/taprdigital.

Also on YouTube

TAPR now has its own channel on YouTube: the TAPR Digital Videos Channel: www.youtube.com/user/TAPRDigitalVideo.

At this time, there are a slew of videos on our channel including many from the TAPR-ARRL Digital Communications Conference (DCC) that you may view at no cost, so have at it!

###

Submission Guidelines

  TAPR is always interested in receiving information and articles for publication. If you have an idea for an article you would like to see, or you or someone you know is doing something that would interest TAPR, please contact the editor (wa1lou@tapr.org) so that your work can be shared with the Amateur Radio community. If you feel uncomfortable or otherwise unable to write an article yourself, please contact the editor for assistance. Preferred format for articles is plain ASCII text (OpenOffice or *Microsoft Word* is acceptable). Preferred graphic formats are PS/EPS/TIFF (diagrams, black and white photographs), or TIFF/JPEG/GIF (color photographs). Please submit graphics at a minimum of 300 DPI.

Production / Distribution

  PSR is exported as Adobe Acrobat and distributed electronically at www.tapr.org

  PSR Editor: Stana Horzepa, WA1LOU

  E-mail wa1lou@tapr.org

TAPR is a community that provides leadership and resources to radio amateurs for the purpose of advancing the radio art.

Membership Application

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Phone +1 972 413 8277, Monday–Friday, 9AM–5PM Eastern Time

E–mail contact@tapr.org   URL www.tapr.org

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Benefits of a TAPR Membership:
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