



President's Corner

DCC with TAPR

By Steve Bible, N7HPR



We are on the cusp of the annual ARRL-TAPR Digital Communications Conference (DCC) which will occur on the weekend of October 9-11 in Chicago, Illinois.

Truth be told, the DCC is actually in Arlington Heights, Illinois, a northwestern suburb of The Windy City... specifically in the DoubleTree by Hilton Chicago - Arlington Heights <<http://tinyurl.com/n2qv9zf>>, which is conveniently located a mere 15-minute shuttle ride from O'Hare International Airport. By the way, if the DoubleTree sells out, there are four other hotels nearby: Courtyard by Marriott and Red Roof Inn are across the street from the DoubleTree, Motel 6 is west 1/2 mile and Holiday Inn Express is north 1/2 mile.

The DCC has two days of technical forums on Friday and Saturday and concurrent introductory sessions on Saturday. Saturday night, the banquet features ham radio writer Ward Silver, N0AX and the Sunday morning seminar will be a deep-dive into a technical topic presented by yours truly.

The following three pages of *PSR* preview the DCC and everything you want and need to know about the amateur radio technical conference of the year. (Updated DCC information is available on TAPR's website at: <http://www.tapr.org/dcc>)

I hope to see you in Chicago and 73,
Steve, N7HPR

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Ward Silver, N0AX

DCC Saturday Night Banquet Speaker

This year, the DCC's Saturday Night Banquet speaker will be Ward Silver, N0AX; his topic will be "Ham Radio - Now What?"

Ward is the Lead Editor of the *ARRL Handbook* and the *ARRL Antenna Book*. He is the author of all three *ARRL License Manuals* and the *Q&A Study Guides* along with writing the monthly *QST* column "Hands-On Radio." The ham radio detective mystery, "Ray Tracy: Zone of Iniquity" is his contribution to the dramatic side of ham radio. He serves as a Contributing Editor to the ARRL and consults on a variety of projects and programs in the ARRL Contest Branch. You will also find his byline in the popular Wiley "for Dummies" series; *Ham Radio* (now in its 2nd edition), *Two-Way Radios and Scanners*, and *Circuitbuilding Do-It-Yourself*.

An electrical engineer, he designed microprocessor-based products and medical devices for twenty years before beginning a second career as a teacher and writer. Ward was first licensed in 1972 as a Novice (WN0GQP) and enjoys DXing, contesting, and participating on his local ARES emergency communications team. He is a founder of the World Radiosport Team Championships and is President of the YASME Foundation.

Outside of ham radio, Ward plays the mandolin, dabbles in digital photography, and enjoys camping, canoeing, kayaking, and Ultimate Frisbee.



Steve Bible, N7HPR

DCC Sunday Seminar Presenter

TAPR President, Steve Bible, N7HPR, will conduct the DCC's Sunday Seminar; his topic will be "3D Modeling for the Radio Amateur."

Back in the day, if you wanted to create a technical drawing you used pens, pencils, parallels, rulers, protractors and all manner of tools for what we called mechanical drafting. Today, we have three dimensional (3D) modeling which is drawing on a computer, or computer aided drafting or CAD. And today it is easier than ever to learn how to 3D model on your computer using a variety of free and pay for programs. Why should you learn? Because 3D modeling is a valuable skill in your hobby and the work place.

In this Sunday Seminar, Steven Bible will introduce you to 3D modeling for amateur radio enthusiasts (and other hobbies) using Autodesk 123D Design, free software for the PC, Mac, or iPad. He will also introduce you to Autodesk Inventor, a powerful 3D modeling tool to show you what you can do with paid subscriptions. To join in this seminar, and to follow along, download Autodesk 123D Design from <http://www.123dapp.com/design>



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Digital Communications Conference

October 9-11, 2014 • Arlington Heights, IL (Chicago)



<http://www.tapr.org/dcc>

Schedule at a Glance

Friday, 9 Oct

8:00 AM Conference Registration and Demonstration Room Open
 8:45 AM Welcome
 9:00 AM Technical Presentations
 Noon Lunch
 1:00 PM Technical Presentations
 5:30 PM Friday Night Social
 10:00 PM Demonstration Room Closed

Saturday, 10 Oct

8:00 AM Conference Registration and Demonstration Room Open
 8:45 AM Welcome
 9:00 AM Technical Presentations
 Noon Lunch
 1:00 PM Technical Presentations
 4:00 PM TAPR Membership Meeting
 6:00 PM No Host Cash Bar
 7:00 PM Dinner Banquet
 10:00 PM Demonstration Room Closed

Sunday, 11 Oct

8:00 AM Sunday Seminar
 Noon

Rooms at a Glance

Registration – Corridor

Demonstration Room – Oakwood A&B

Friday

Main Session Technical Presentations – Arbor C&D

Lunch – Arbor A&B

DCC Social – Arbor C&D

Saturday

Main Session Technical Presentations – Arbor C&D

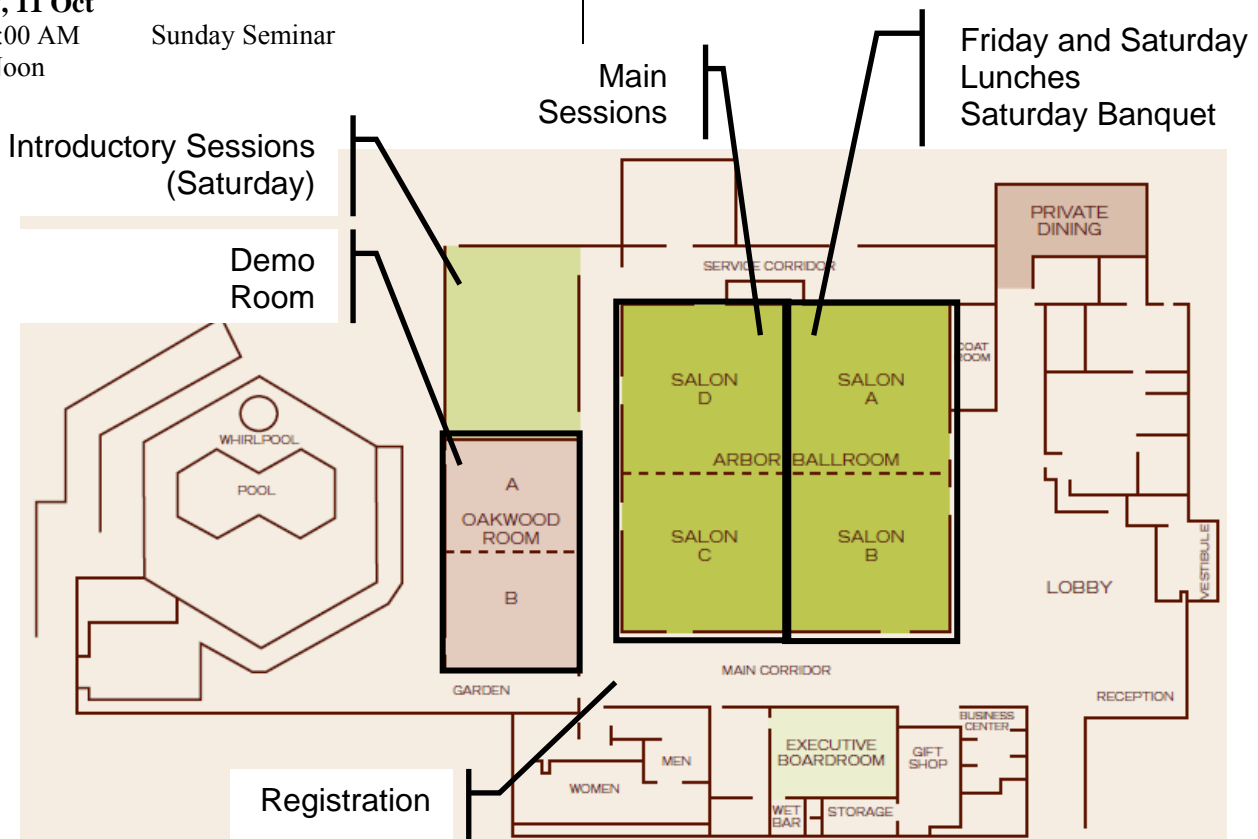
Introductory Sessions Presentations – Oakwood C

Lunch – Arbor A&B

Dinner Banquet – Arbor A&B

Sunday

Sunday Seminar – Arbor C&D



Preliminary 2015 DCC Conference Schedule

	Friday	Saturday	Sunday	
8:00 AM	Conference Registration Demonstration Room Open	Conference Registration Demonstration Room Open	Sunday Seminar 8:00 AM – 12:00 AM 3D Modeling for the Radio Amateur Steven Bible, N7HPR	
8:45 AM	Main Session Welcome and Introductions	Main Session Welcome and Introductions		Introductory Session
9:00 AM	TASS John Ackermann, N8UR	Modulation – Demodulation Software Radio Alex Schwarz, VE7DXW Guy Roels, ON6MU		Intro to Digital Voice Standards John Hays, K7VE
9:45 AM	Network Bandwidth Considerations for Digital Voice Systems Bryan Hoyer, K7UDR	Echosounding the Ionosphere with SDR Tom McDermott, N5EG		
10:30 AM	Amateur Radio Voice and Data Network Interconnection John Hays, K7VE	The AREDN Project (AREDN.org) Andre Hansen, K6AH		FreeDV with SM1000 Mel Whitten, KØPFX
11:15 AM	Challenges with the Open Hardware Model Bruce Perens, K6BP	A Radio Server for all purposes; Talking to the Radio with your Browser Phil Theis, K3TUF		
Noon	Lunch	Lunch		
1:00 PM	Update on DATV-Express Exciter for Digital-ATV Ken Konechy W6HHC	QRPi – A Raspberry Pi QRP TX Shield Design; Zoltán Dóczi, HA7DCD Zoltan Doczi, HA7DCD	D-ATV Using DVB-T Mel Whitten, KØPFX	
1:45 PM	HF Receiver Testing: Issues & Advances Adam Farson, VA7OJ/AB4OJ	OpenWebRX: SDR Web Application for the Masses Andras Retzler, HA7ILM		
2:30 PM	Arduino CAT Controller for HPSDR John Melton, GØORX/N6LYT	An OS Independent and Device- Independent Mobile Web Front Panel for Radio Transceivers Bruce Perens, K6BP		
3:15 PM	ARDOP (Amateur Radio Digital Open Protocol): A next generation digital protocol for HF and VHF/UHF Rick Muething, KN6KB Matthew Pitts, N8OHU John Wiseman, GM8BPQ	SatNOGS: Satellite Networked Open Ground Station Daniel J. White, Ph.D., ADØCQ		
4:00 PM	Play Time in the Demonstration Room	TAPR Annual Meeting Play Time in the Demonstration Room		
5:30 PM	Friday Night Social			
7:00 PM	No-Host Cash Bar	Dinner No-Host Cash Bar (6:00 PM) Dinner (7:00 PM) Banquet Speaker Ham Radio – Now What? Ward Silver, NØAX Awards Presentation Prize Drawings		
10:00 PM	Demonstration Room Closed			

The advertisement features a background image of the Chicago skyline at dusk, with the Willis Tower prominently visible. In the top left corner is the ARRL logo, a diamond shape containing a circuit diagram with the letters A, R, and R. Below it is a photograph of the DoubleTree by Hilton Chicago - Arlington Heights hotel. In the center is the TAPR logo, a blue stylized 'Y' shape with 'TAPR' written vertically to its right. The main title '2015 ARRL/TAPR Digital Communications Conference' is in large yellow and white text. Below the title, the dates 'October 9-11 in Chicago, Illinois' are displayed. A white text box on the right contains the conference details and contact information.

2015 ARRL/TAPR Digital Communications Conference

October 9-11 in Chicago, Illinois

Make your reservations now for three days of learning and enjoyment at the DoubleTree by Hilton Chicago – Arlington Heights hotel. The Digital Communications Conference schedule includes technical and introductory forums, demonstrations, a Saturday evening banquet and an in-depth Sunday seminar. This conference is for everyone with an interest in digital communications—beginner to expert.

Call Tucson Amateur Packet Radio at: **972-671-8277**, or go online to **www.tapr.org/dcc**

TASS Coaxial Relay System

The TASS (Totally Awesome Switch System) is a general purpose DC-150 MHz relay-based switch. The hardware is designed to be very generic with functionality implemented in an inexpensive microcontroller such as an Arduino. The TASS has many uses from switching signal sources on a test bench or in a laboratory to selecting receive antennas and filters in a ham or SWL station.

There are two boards in the system: the TASS-R relay board, which does the mechanics of signal switching and provides a very simple 10-pin interface and the TASS-SHIELD board for use with an Arduino Mega 2560 microcontroller. The TASS-SHIELD allows up to four TASS-R boards to be controlled simultaneously. And you can daisychain two or more TASS-Rs to create a bigger switch.

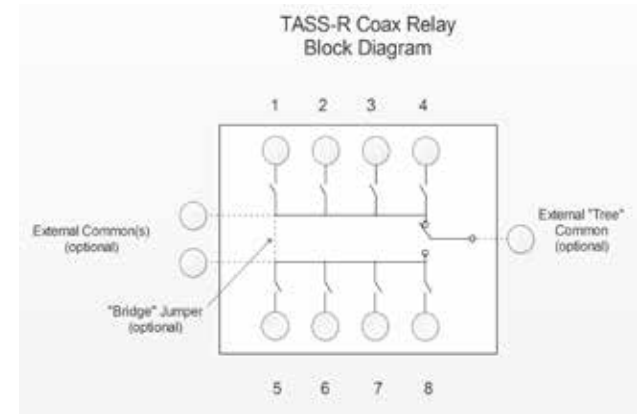
The final component is open source software for the Arduino that acts as an interface between a host computer or other input system, and the switching hardware.

Note these important points:

- The TASS-R board can handle 10W of RF power. It is not intended for use with greater-than-QRP level signals.
- The TASS-R board requires nine digital control signals for full functionality. Thus, an Arduino R3 or similar board can control a single TASS-R, but may not have enough I/O lines available to support touchscreen, Ethernet, or other add-on components.
- The TASS-SHIELD mates to an Arduino Mega 2560 processor, which provides enough I/O to support four TASS-R boards with lines left over for other uses. TAPR does not provide the Arduino, but it is available from many sources for less money than TAPR would have to charge.

Documentation, including a short introductory video, and Arduino software, can be downloaded from <http://tapr.org/~n8ur/TASS/> Documentation and software are still under construction, so check for updates.

TASS-R costs \$119 and TASS-Shield costs \$19 (plus shipping/handling, if applicable). Order here: http://www.tapr.org/kits_tass.html



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Directors Election

Three Director positions on the TAPR Board of Directors are now open for nomination and nominations may be submitted now.

TAPR Board members serve three-year terms and their responsibilities include:

- 1) Attendance at both board meetings each year. [One is held at the Dayton Hamvention in May, the other at the Digital Communications Conference (DCC) in September.]
- 2) Regular participation in the continuous board session, which is conducted over the Internet.
- 3) Active engagement in TAPR's management.

To place a person in nomination, please remember that he or she must be a member of TAPR. Also, confirm that the individual is willing to have his or her name placed in nomination. Send that person's name (or your own if you wish to nominate yourself), call sign, mailing address, e-mail address, phone number(s), and a biographical sketch (100 words maximum) via

<http://www.tapr.org/inforequest.php> or to via snail mail postmarked by October 1, 2015, to P. O. Box 852754, Richardson, TX 75085-2754.

If you submit a nomination via e-mail, we strongly encourage you to follow up by regular mail.

Nominations close after the call for nominations from the floor at the TAPR Membership Meeting at the DCC on October 10, 2015, and an online election will be held at http://www.tapr.org/tapr_elections.html from October 17 to 31, 2015.

The three Director positions that are up for election are currently held by George Byrkit, K9TRV, Tom Holmes, N8ZM, and John Koster, W9DDD.

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

Know KD6OZH's Work?

TAPR is looking to connect with anyone who had worked with the late John Stephenson, KD6OZH, on his ODFM and/or HSMM technology developments and experiments.

TAPR is in possession of John's technical work on ODFM & HSMM and would like to identify hams who are interested and capable of moving his developments forward.

If you have worked with KD6OZH or are interested in advancing his technical work please contact John, W9DDD at the TAPR Office at: w9ddd@tapr.org

In the meantime, you can learn more about KD6OZH's technical work at: <http://www.arrl.org/high-speed-digital-topics>

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(from the WAILOU collection)

Audio and Video Online

Gary Pearce, KN4AQ, the brains behind HamRadioNow has posted videos of TAPR's presence at the 2015 Hamvention, that is, the Friday morning TAPR Forum and the Friday evening TAPR-AMSAT Banquet.

Episode 207 is in two parts and is a video of the six presentations made at the TAPR Forum. Part 1 is here:

https://www.youtube.com/watch?v=7mAFP_c0B6g and Part 2 is here:
<https://www.youtube.com/watch?v=eAzkSP2nt0M>

Episode 211 <<https://www.youtube.com/watch?v=LpSIGKqeZ4I>> is a recording of the TAPR-AMSAT Banquet featuring Mike Ossmann, AD0NR, and his after-dinner talk titled "Adventures of a Hacker Turned Ham."

A directory of HamRadioNow and ARVN videos of past DCCs can be found here: <http://tinyurl.com/neguaaa>

Courtesy of Dave Larsen, KV0S, videos of the TAPR Forum are also viewable here on the openHPSDR website:
<http://openhpsdr.org/videos.php>

Jeremy Kolonay, KF7IJZ, interviewed TAPR folks during his Fo Time! Hamvention in podcast <<http://amateurradio15.com/26/>>. Steve Bible, N7HPR, is on at time 21:45, Michael Ossman, AD0NR, is on at 56:50, and Chris Testa, KD2BMH, at 1:13:40.

Budd Churchward, WB7FHC, posted a video on YouTube of Jeremy McDermond, NH6Z, presenting his HPSDR Update at the March 2015 MicroHAMS Digital Conference in Redmond, WA:
<<https://www.youtube.com/watch?v=DgyG-50TBzs>>

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!



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Converting a Packet/Winlink Station to Raspberry Pi – A Linux Saga

By Steve Fischer, K6ETA

The name here is Steve K6ETA. I've been in this great hobby for a mere three years – but I always seem to be jumping into it with both feet. Suffice to say I'm exploring many aspects of amateur radio – and VHF Packet is no exception!

After getting the usual introduction to VHF packet by way of acquiring a Kantronics KPC3+ and digitally checking in to the local RACES nets, I decided I would go further and stand up a Winlink RMS. This sent me on a journey meandering through sound card soft-TNCs like AGW/Signalink and later Direwolf, KISS TNCs like the TNC-X, and of course checking out the HF digital modes.

Eventually I ended up with an HF/VHF Winlink RMS station and PBBS. But after converting the station to 24/7 solar-charged battery power, it became obvious that the computer needed to manage the station was the big power hog.

So in November of 2014 I decided to look into converting everything over to the 5V 1A Raspberry Pi. What follows is a chronicle of my travails – from banging my head against the Linux wall to finally breaking through the other side with a complex and functioning packet and Winlink station.

As the end of November 2014 approached and work was slowing down for the holidays, I ordered my first Raspberry Pi. It was a B+ variant and I quickly got a dose of the Linux experience.

I also ordered two TNC-Pi KISS TNCs that are designed to stack on top of the Raspberri Pi – very slick!

<http://tnc-x.com/TNCPi.htm>

The flavor of Linux that is most popular amongst amateur radio enthusiasts using the Raspberry Pi is called Raspbian. It's a variant of Debian and comes with AX25 tools and services built in at the kernel level. Nice!

But what wasn't so nice at the time was a documentation nightmare I soon experienced.

Looking for a beaten path to getting a packet/Winlink station going on the Raspberry Pi was like trying to find instructions on how to build a tree fort out recycled scraps. There were hundreds of ideas out there, mostly about as complete as an idea sketched on a napkin. This is understandable because Linux is a maker's platform. Often the geniuses who write the software, on their own time no less, don't have the time or energy to write complete documentation as well. But if the tools offered aren't deployable, much of that genius goes to waste. So I'm not trying to be ungrateful here, just practical.

First of all, you have to understand that I'm a bit of a computer geek. I have played with, built and customized just about every type of workstation, machine or hack-box short of a Linux server, so Linux was the only real curve for me here.

Even so, the only somewhat understandable options I found for packet/Winlink were LinBPQ, an FBB/FPAC build offered by a French station and a few How-To websites that assumed a level of Linux experience I just didn't have yet. So I decided to take the more common approach and

just go with BPQ.

At the time, the LinBPQ option seemed fairly well tested, but struggling with the vague installation instructions offered resulted in hours wasted and some notable frustration. The online references I found were often woefully out of date and there simply was no single how-to that would result in a working build. Compiling software caused many errors due to undocumented prerequisites, etc. After asking around about these issues, I was told to join an email list and ask questions – but I’m a HAM, darnit, so I wasn’t about to do that!

After enlisting the help of an IT friend (Kris, KK6AYC) we both agreed that the documentation was incomplete... so the project stalled out.

Then the 2014 Christmas holidays arrived and I found myself with time to devote to this goal. So I shelved BPQ and tried JNOS. This proved to be instantly more confusing as AMPR networking and TCP/IP prerequisites were suddenly thrown into the curve. I also found out by asking around that BPQ and JNOS don’t even use the native AX25 capabilities of Linux and instead layer their own AX25 stacks on top, ported over from the everyone’s favorite bloatware – Microsoft Windows.

So I went back to look again and found a complete (and native, yay!) FBB/FPAC image generously offered up by Bernard, F6BVP, found here:

http://f6bvp.org/AX25_BBS_Node_RaspBerry_Pi_install.html

FBB is a tried-and-true full-service BBS system. My early research showed that most modern BBS functions and forwarding schemes (even Winlink’s B2F) are based on the excellent FBB software. Plus it’s still being developed, so it seemed like a great fit!

Following Bernard’s more complete documentation I was able to get a station somewhat functional. There were still several stumbling blocks such as the lack of Winlink (which is illegal in France); an assumption of a certain level of Linux expertise; assumptions that a new sysop would know about FBB forwarding, hierarchical addressing, etc.; and the problems that come with an image not built for multiple TNC-Pi ports and the most current hardware.

But what Bernard’s image really did for me was to offer me a nice example of a system that was well-structured and nearly complete. This was a true gift. Also, his documentation was so much better than the other builds I had tried that I was able to gather a lot about how the components work and interact.

But I needed Winlink and the station still didn’t function yet – so I went back to the drawing board and consulted my only Elmer at that point – Google.

But thanks to Google, I finally found both much better documentation and a true Elmer at a website put up by Charley, K4GBB. See his site here:

<http://k4gbb.us/docs/Raspberry.html>

AH! Finally step-by-step instructions that resulted in a working system! This was a HUGE breakthrough after countless hours of banging my head against the walls of poor documentation combined with noob-hood.

To make things even better, Charley was extremely helpful and responsive to questions – and soon he was helping me customize my own stable build! Big thanks to Charley and kudos to his help and enthusiasm!

Even with all this expert help, quality Elmering and finally a fairly complete set of reference instructions, it was still about halfway into January before I had the build I had originally set out to assemble way back in November.

So I ended up with a Raspberry Pi running a full-function FPAC Node with NetRom, ROSE, Telnet, and the possibility of AMPRnet and also providing a full-service FBB BBS with sophisticated forwarding – as well as a Winlink RMS and all working on 3 different frequencies! All this in a package about the size of a bar of soap using only 5V 1A. Nice!

Thinking that what I wanted to build wasn't so unusual and that many other hams might want to deploy something similar, I decided to give something back and fully document – and hopefully even automate – the installation process.

But then I ran into a recurring theme I've since seen all over the Linux world.

It goes something like this: “If you hand people a running build on a silver platter, they won't learn about all the magic that happens under the hood”.

While I could see that point, it was also rather one-sided and limiting. What I was being told in varying degrees by several Linux developers was that those who don't spend months learning Linux essentially don't deserve to have running Linux servers or appliances. So much for real world deployments!

That just didn't sit well with me. Here I had gone through literally months of effort (my estimate is 300-400 hours) to get a fairly common station going. It just shouldn't be that hard. If we could cut that down to 2-4 hours why wouldn't everyone want that? You would still need to

learn to use all that software and hardware, and those who were serious would keep learning about the “magic under the hood” regardless.

While helping other local hams Bob, AI6EE, and Brett, K6BPS, stand up similar stations, it became clear that lending a helping hand greatly accelerated the build process, making getting a running station possible in just a few days of working on it here and there. Bob, being a networking tech also helped us solve a lot of NetRom issues. So there was contributive knowledge to give back too!

Brett, K6BPS, agreed with me that putting up more complete documentation – and even writing a more complete installation script based on the one provided by Charley, K4GGB – would be a huge benefit to anyone standing up a packet/Winlink station on Raspberry Pi.

So we set out to do it.

Brett put a tremendous amount of work into customizing the install and compile script based on the one provided by Charley K4GGB. He also did a great job documenting every detail of the process. This time we made sure nothing important was left out.

Together we created two options for installation: a step-by-step manual installation and configuration process to maximize learning; and an automated installer that asks you the information you would like to have configured in your build – that results in a working station in about an hour!

I created a wizard script that presents a series of windows that asks for call sign and station information and automatically changes all the myriad and confusing configuration files “under the hood” to end up with a functioning build. Basically automating what took so long to unearth over those winter months.

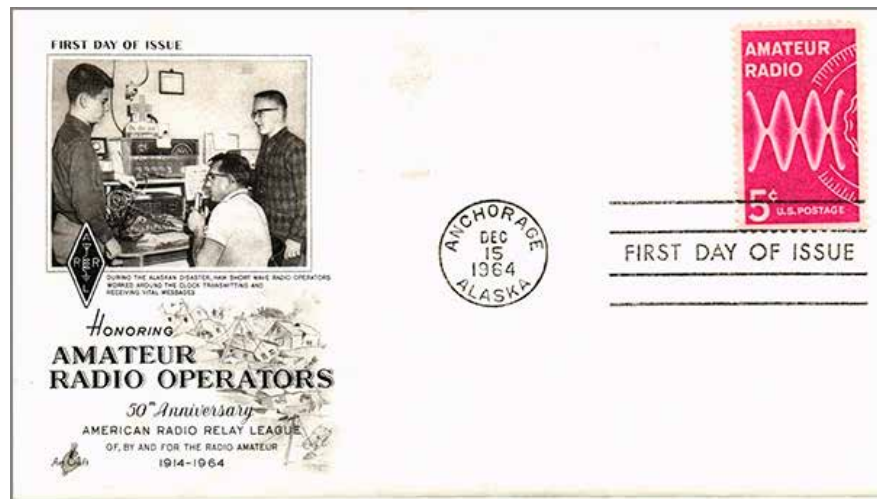
So the fruits of that effort are humbly offered to all and can be accessed at Brett's website here:

<http://ax25.thinkonit.com/>

Thus ends the chronicle of my travails and in the end successes with packet and Winlink on the Raspberry Pi.

Epilogue

There's a new effort that goes even farther than Brett's and mine called HAL Digital. Instead of ending up with an FPAC Node with FBB and Winlink using just the TNC-Pi hardware, HAL will give you a URONode with FBB using multiple different TNC options including the Direwolf soundcard soft-TNC. Brett and I have jumped in to help with that effort (mostly testing and providing feedback based on our efforts above). Look for it soon!



Write Here!

Your *PSR* editor is patiently waiting for 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 wallou@tapr.org, she can handle it!

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

If *PSR* publishes your contribution, you will receive an extension to your TAPR membership or if you are not a member, you will receive a TAPR membership.



What's On Your Bench?

By Dan Quigley, N7HQ

How many times have you not pursued a project idea because producing it requires access to capabilities well beyond the reach of your skills, bench or pocketbook?

Have you ever found yourself wishing some manufacturer would just wake up, and take an accessory with that “one feature” that completes your station to market?

(This next one is my personal favorite.)

How about the product with every feature you could need or want. In fact, you would buy one today, except it needs an additional connection or interface port of some kind. And, to fully utilize the capabilities that product offers, you must purchase more than one of them!

Those days are over folks, the ram has touched the wall.

Over the past decade, a world-wide DIY culture and Phenom market has emerged and is attracting a serious number of people. It has captured the attention of startup and big business alike. In the US alone, the Maker Movement as it is known, is sized at over 135 million adults and that is 2-year-old data from this *USA Today* article <<http://tinyurl.com/qz5bhr9>>. Martha Stewart is considered a Maker. That market represents a staggering 57% (and growing) number of Americans over 18-years-old. Moreover, it is contributing over \$29 billion into the economy each year. To help put that number into a more familiar perspective, the US coffee stand barista business clocks in at about \$30 billion.

Shared laboratories and workshops, outfitted with big-boy computer-controlled tools like CNC machines, laser cutters and commercial 3D printers are springing up in municipalities across the world. Known as Fab Labs<https://en.wikipedia.org/wiki/Fab_lab>, they also function as

local gathering places for Makers. Sound familiar? Though I can't find a quotable statistic. The movement is most certainly helping to fuel and spark a resurgence of interest in amateur radio. That's pretty exciting! But not the most exciting thing!

The Maker culture has the solid attention of fabricators that previously tailored their businesses to support mainstream manufacturers. These vendors offer an array of services providing the means to produce custom electronic or mechanical/craft assemblies of any kind and usually at prices one can afford. For Geoffrey Moore subscribers, the Maker market has crossed the chasm and is in the Early Majority stage, so all you Late Majority members get ready.

Using readily available (and predominantly free) software tools, you can now engineer, design and realize just about anything you can dream up. You can submit your design to on/off-shore facilities to be manufactured and shipped right back to you in a week or two. In a hurry? You can get 24-hour turnaround for a price that doesn't required a chat with your banker. If you lack the skills or time to design what you want, some businesses offer contract engineering and design services. Some operate exchanges where skilled engineers and designers share their designs and bid on projects described by other community members.

The great thing about all these services is they specialize in batching smaller orders into larger production runs, yielding prices that even the most conservative among us will consider. Want an example? I just received 10 copies of a 2-layer ~10cm² custom, US-produced PCB for \$10 + \$12 shipping. That is \$2.20 per board!

Maker market manufacturing capabilities extend well beyond circuit boards. There are firms that produce custom laser-cut, wood, plastic or

powder-coated/anodized aluminum enclosures and control panels, and it doesn't end there. Need a replacement knob, metal/plastic part that is impossible to find? There are CNC milling and 3D printing services that will make them for you. For under \$100, you can have a precision manufactured, custom enclosure with engraved lettering.

If you can't or won't deal with SMD parts? Provided your design uses components from a standardized list, one firm will manufacture the circuit board, then populate, solder and test your design, for \$.05 per pin plus the cost of parts. 300 pins = \$30. That's pretty amazing when you consider that not too long ago, group projects or "buys" were the only way to accomplish such things.

This is Edward Heath's business premise and vision on steroids. But to derive full advantage of this you must start with an understanding of the design and development toolchain and there are some choices. Since it is of interest and not unfamiliar to readers here, let's start by looking at PCB design tools.

Schematic Capture and PCB Layout Software

At the front-end of the circuit design process is the creation of a schematic and its related PCB layout. Typically the circuit is entered into a computer using an editor purpose-built for the task. Components are selected from libraries and interconnects are typically drawn with a mouse. Once the schematic for the design is complete, it can be transferred into another software tool with CAD capabilities, designed to layout the schematic onto a virtual PCB surface. From there a package of files is exported (containing the necessary data) and formats compatible with the manufacturing systems used by fabricators.

There are three essential capabilities to look for in a Schematic/PCB

tool set;

1) Support for the RS-274-X or Gerber file standard.

Some commercial PCB fabricators provide their own (free) schematic capture and PCB layout software online. Free is parenthetical, as many of these services try to lock you in to their offerings by using a proprietary design file format or some other mechanism requiring an order with that specific vendor to realize the design. My personal experience with these services is they produce high quality results, but are typically too costly for hobbyist prototype designs. In fact, they can cost upwards of 5 to 10 times that of the services emerging to support the Maker market.

2) Component library and footprint creation and editing.

Manufacturers are constantly adding new components to their product mix and face it, hams don't always use mainstream components. So no ability to create or modify the components used in your designs is a show-stopper.

3) Eagle library format import and/or conversion support.

Almost all tools come with some default component library. But not one I have looked at has every component needed in a design. The Eagle library format is ubiquitous, and many component manufacturers publish Eagle formatted or compatible library files. Be prepared to spend a lot of time in the component editor if you can't easily convert from Eagle library formats to the native format of your design tool.

Some Examples Tools

Like many engineering design tools, utility is dependent on experience with use, knowledge of features and behaviors and user preference. Some people feel very strongly about their tool and some are happy to debate

various merits and such. But in the end, it is a choice. Here are three I considered that have the three essentials.

CadSoft's Eagle CAD <<http://www.cadsoftusa.com>> is entrenched as the software of choice for many hobbyists, primarily because it is available as freeware, limited by PCB size 4" X 3.2" (100mm X 80mm), and enjoys the broadest selection of schematic symbol and PCB footprints. CadSoft sells a range of less-limited versions for example, a Hobbyist version retails for \$169 and supports board sizes of up to 6.4" X 4" (160mm X 100mm).

Eagle is a strong product and supports Windows, Mac and Linux systems. It is popular enough to set the de facto component library format standard. Eagle has, at least for me, a show-stopper drawback; the non-intuitive user interface. It simply does not follow the conventions used by nearly every other mouse-driven software program out there. For some, Eagle is the best tool for the task. For myself, the learning curve requires an investment in time and patience I simply don't have.

KiCAD <<http://kicad-pcb.org>> is also a popular tool. It is open source and supports 3D rendering; which can be very useful. It sports an intuitive UI and the learning curve isn't steep. Though I haven't personally used KiCAD in my design work, there are plenty of people that do.

Novarm's DipTrace <<http://diptrace.com>> is my personal choice. I was up and running with this software in less than an hour. It has all three of the essentials plus 3D rendering. I especially like the ability to import Eagle schematics directly, so any Eagle design (or library) can be leveraged.

Novarm has a free version for hobbyists and instead of board size,

DipTrace restricts the number of board layers and pins used in the design (a much more ham-friendly restriction in my opinion). The free version allows two layers and 300 pins. However, if you send them an email and explain that you are a hobbyist, student or a non-profit, they will send you a registration key unlocking an entry-level or "lite" version allowing 500 pins and 2-layers; a threshold I have yet to cross.

Novarm is chasing the maker market and offers substantial discounts to hobbyists at all advertised commercial license levels. For example, I have some ideas that likely will require a 4-layer board. So once the family budget allows, I plan to upgrade to the Standard version (1000 pins and 4 layers) for \$125. Commercial users will pay \$345 for the same license. If I get really serious, their top-of-the-line unlimited version (for a hobbyist) is \$348.

There's more, a lot more to discuss and learn about this remarkable windfall for our hobby. It has the economics and momentum to attract a new generation with capabilities we could only dream about a few years ago.

The bottom line? We now have an amazing array of affordable commercial fabrication capabilities to use. The companies behind them not only want our business, they are competing for it! It's time to get to work and make something.

So what is on my bench right now?

I ripped the guts out of a Heath SB-634 station console and am rebuilding it to be my personal version of a station console. Intended to visually match and eventually integrate with a similar revision to my HPSDR station, which will eliminate any requirement to control that system with a traditional PC. I am using an Arduino-compatible

microcontroller as the glue.

Here are the feature specs:

- Dual 240/120VAC and 13.8VDC supplies
- 7-segment low-power LED Time and ID timer displays
- Ethernet connectivity to other station components
- Web pages for configuration and monitoring
- GPS-disciplined 10MHz frequency reference (for the HPSDR gear) using a surplus Trimble Thunderbolt GPS unit.
- GPS disciplined station clock and ID timer.
- GPS disciplined NTP server (provides accurate time to the other devices on my network)
- Automatic fallback from GPS to battery-backed hardware real-time clock.
- Bluetooth HFP (hands free profile) phone patch, also allows me to use my nice Bluetooth headset when operating.
- Replace the bank of mechanical switches with modern illuminated TACT switches and digital switching
- Legal limit digital power meter digital logging of SWR, forward and reverse power
- All front panel controls retain their labeled functions.
- The legacy analog meter shows SWR, forward and reverse power levels, VU values for patch and other signal levels.
- I2C controlled FM Stereo receiver (for \$4.95 I reclaim a little shelf space and get to listen to the game)

- New laser-cut aluminum rear-panel design with engraved lettering (using a maker local market service!)

The best part is, if I think up a better feature or use case, I can change or add it without checking interest rates or with the XYL first. Now it just doesn't get any better than that.

What's on your bench?

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