Winlink Protocols and Pat

Data Transmission on Radio

RMHAM University

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Your Host

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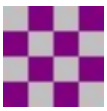
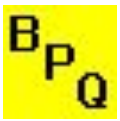
Winlink Ecosystem



Winlink Express



BPQ

WoAD

Pat

Airmail

PacLink

Winlink isn't made up of just one program, or even programs just from Amateur Radio Safety Foundation, Inc. (ARSFI), Winlink's owner organization. It's an entire ecosystem with third-party clients and RMS programs, too!

Protocols and You

To understand how these programs work together, we need to look at the protocols involved.

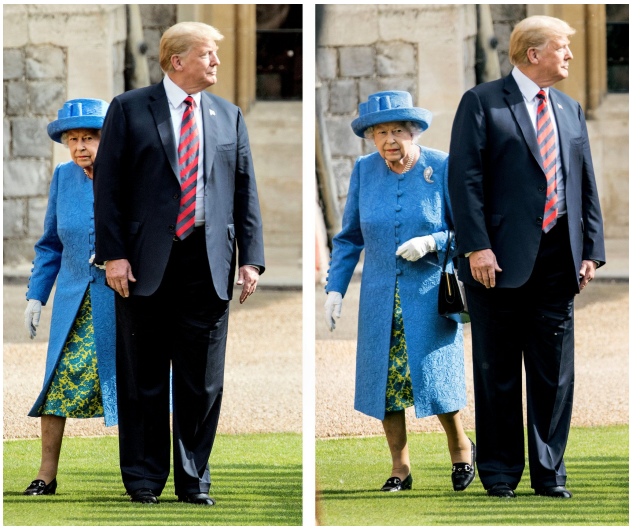
What exactly is a Protocol?

Before I became a programmer, the word "protocol" was sort of mysterious and a little intimidating.

Human Protocol

Let's talk about protocols in human terms first. When you meet the Queen of England, there's a strict protocol about what you can and can't do, who stands where, who sits or stands back up first, etc.

Human Protocol



When you don't follow protocol, people get confused and upset!

Ham Voice Protocol

K9RUN, QRZ?

K0SWE

K0SWE you are 59, 398

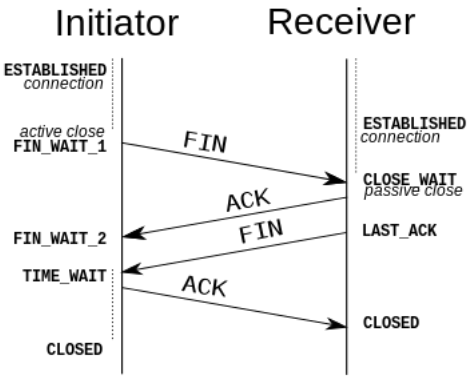
Roger K9RUN you are 59, 32

RR, GL, QRZ?

This is W0LID, it's a fine day here in Reno, although my leg is acting up…

Similarly, on the air, there are voice mode protocols. If you hear a station running during a contest, there's a predictable flow and order to who speaks when and what they're supposed to say. If you break in trying to ragchew, people are going to be confused and upset!

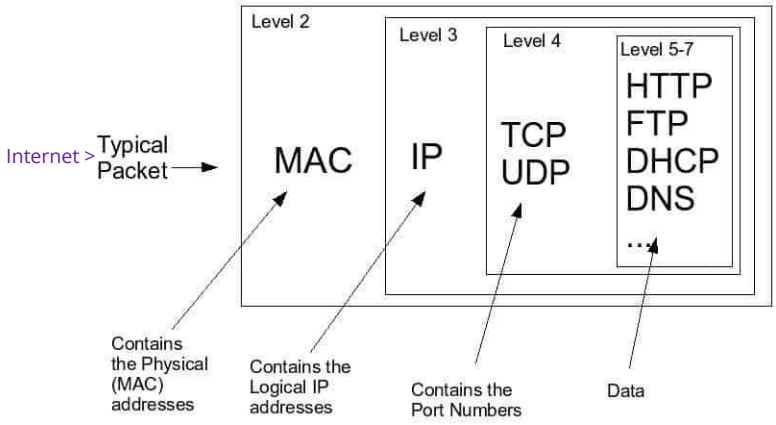
Technology Protocol



Computer protocols are the same: the define what information is supposed to be sent, and in what order. Machines are dumb, so this needs to be highly strict and formal.

Think of it as a language: if two or more communicators are "speaking" the same protocol, they'll be able to understand each other. If they're not speaking the same protocol, they're just noise to each other.

Payloads



Many digital protocols contain room for payloads, which allow embedding or "encapsulating" information from a higher-level program. This lets us build an entire stack of protocols that have different responsibilities and are reusable for more than one type of communication.

Why layered protocols?

- Each protocol solves one specific problem
- Low-level protocols reusable with new high-level applications

OSI 7-layer model

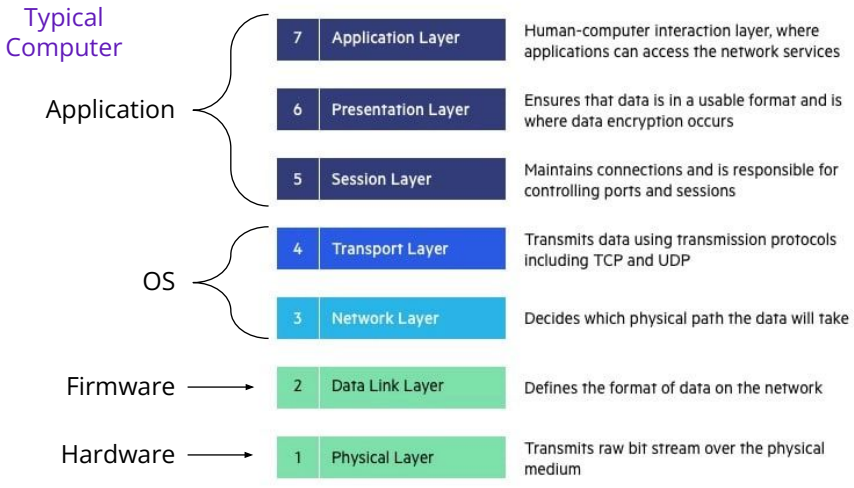
Woops, wrong 7 layers…

OSI 7-layer model

7	Application Layer	Human-computer interaction layer, where applications can access the network services
6	Presentation Layer	Ensures that data is in a usable format and is where data encryption occurs
5	Session Layer	Maintains connections and is responsible for controlling ports and sessions
4	Transport Layer	Transmits data using transmission protocols including TCP and UDP
3	Network Layer	Decides which physical path the data will take
2	Data Link Layer	Defines the format of data on the network
1	Physical Layer	Transmits raw bit stream over the physical medium

It's useful to know about the Open Systems Interconnection (OSI) model of network communication. It defines 7 different levels of concern/responsibility, stacked in a certain order.

OSI 7-layer model

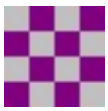


In a typical computer network connection, layers 5-7 are usually implemented by applications, 3 and 4 by the operating system, layer 2 by firmware and layer 1 by hardware.

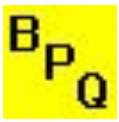
Amateur radio doesn't use every layer and arguably has some additional layers, but it's still a useful model to know about.

Protocols and Ham Radio

Winlink *lingua franca*


Winlink Express

Pat



BPQ


Airmail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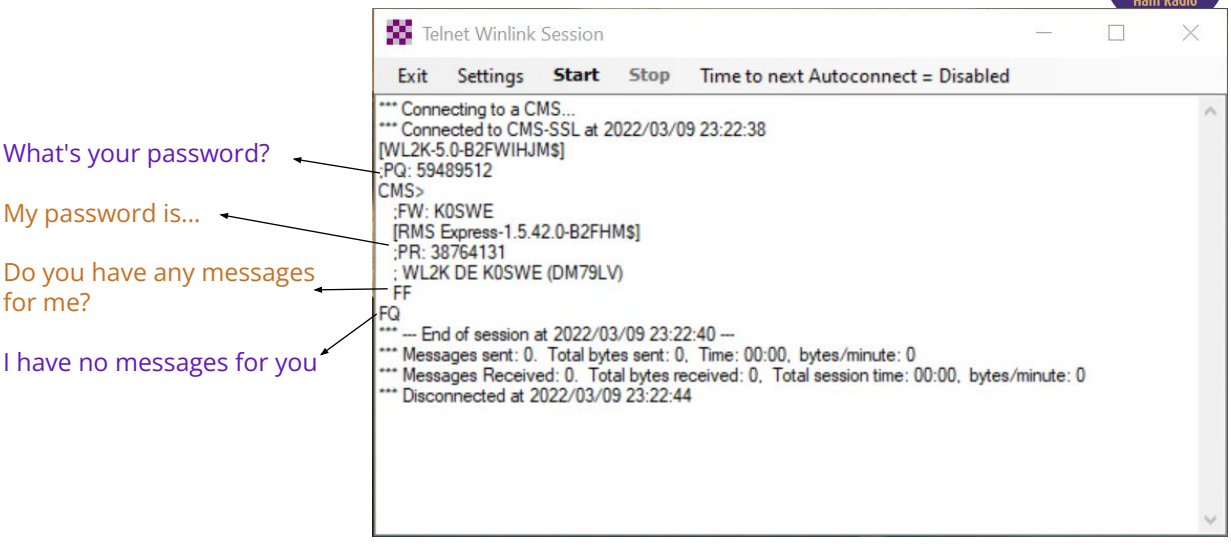
PacLink

B2F

All Winlink programs can talk to each other because they all speak a protocol called B2F.

B2F in action



B2F defines requests and responses like

- "Please send your password," (PQ)
- "Do you have any emails for me?" (FF)
- "I have a message waiting for you" (PM)

B2F also extends an older protocol called FBB which defines how the emails themselves should be formatted.

B2F does not know about frequencies, callsigns (other than using them as usernames), FM vs SSB, etc. Those details are handled by lower-level protocols.

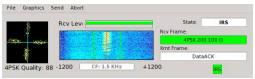
Winlink transport protocols

Rocky Mountain Ham Radio

B2F

AX.25

Packet



ARDOP

Telnet

VARA

PACTOR

B2F and FBB can be carried over multiple transport protocols. The transports shown here accept payloads and can be used to carry more than just Winlink traffic, but Winlink is a common use for each.

Telnet is basically just "the internet" and does routing based on IP addresses and domain names.

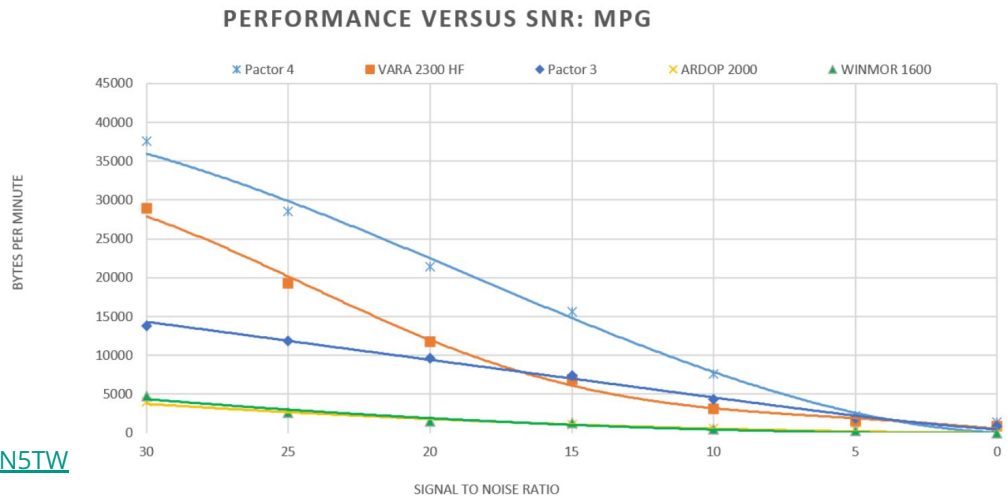
All of the other protocols are for RF and do routing based on frequency, destination callsign and possibly digipeater/relay stations.

Why so many transports?

- Telnet
  - Uses TCP/IP, a.k.a. The Internet. Often the simplest and fastest option, but not very exciting because there's no radios involved!
- AX.25
  - Mature, open FM protocol; a lot of supported hardware & software; digipeating
- ARDOP
  - Free and open source for HF
- VARA & VARA FM
  - Very fast, very reliable, software, reasonable cost
- PACTOR
  - Very fast, very reliable, high hardware cost

Each of the supported transports has pros and cons.

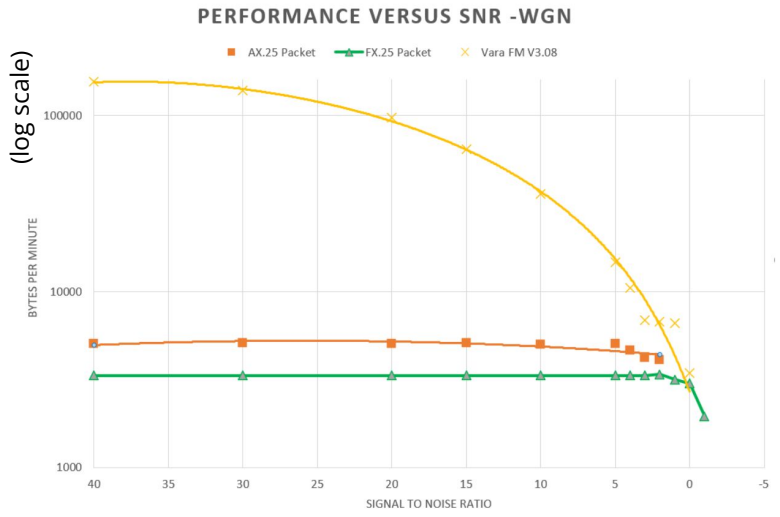
HF Transport speed comparison



Source: N5TW

1. Pactor 4 (not yet legal in the US except by waiver)
2. VARA HF
3. Pactor 3

VHF Transport speed comparison

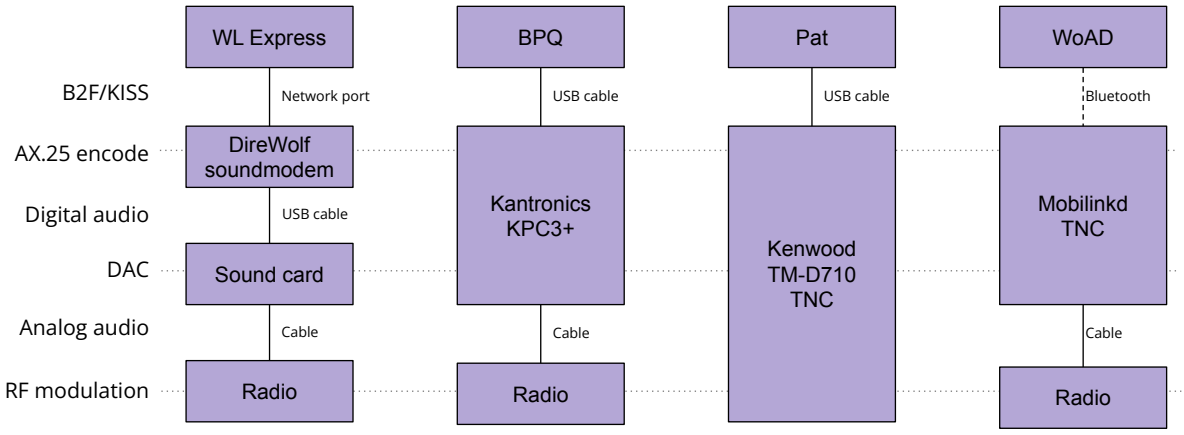


Source: N5TW

VARA FM is *much* faster than AX25!

FX.25 is an evolution of AX.25 to use Forward Error Correction (FEC). Unfortunately, that means it spends longer sending the same amount of data, so under most conditions it's even slower than AX.25. The only advantage it has is that it will operate slightly under the noise floor, which neither VARA FM nor AX25 will do.

Different stacks: AX.25



This diagram illustrates some of the many ways to implement a Winlink station, and the roles that the different components fulfil.

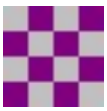
Some options are easier to configure. The Kenwood TM-D710 implements everything from the KISS interface to RF, so it's one of the simplest things to configure. No tuning AF gains, no choosing sound cards, no matching up network ports.

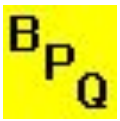
On the other hand, consider wanting to switch from AX.25 to VARA FM. Only the stack on the far left with the sound card would still be usable. All of the other options (Kantronics, Kenwood, Mobilinkd) only speak AX.25.

(P.S., I don't know if WoAD can actually use the Mobilinkd TNC, but theoretically it could.)

Pat

Winlink Ecosystem


Winlink Express



BPQ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PacLink

I said earlier that there are multiple Winlink clients. Gary already showed you a bit about Winlink Express, but I'm going to dive deeper on one of the alternate clients: Pat!

Pat

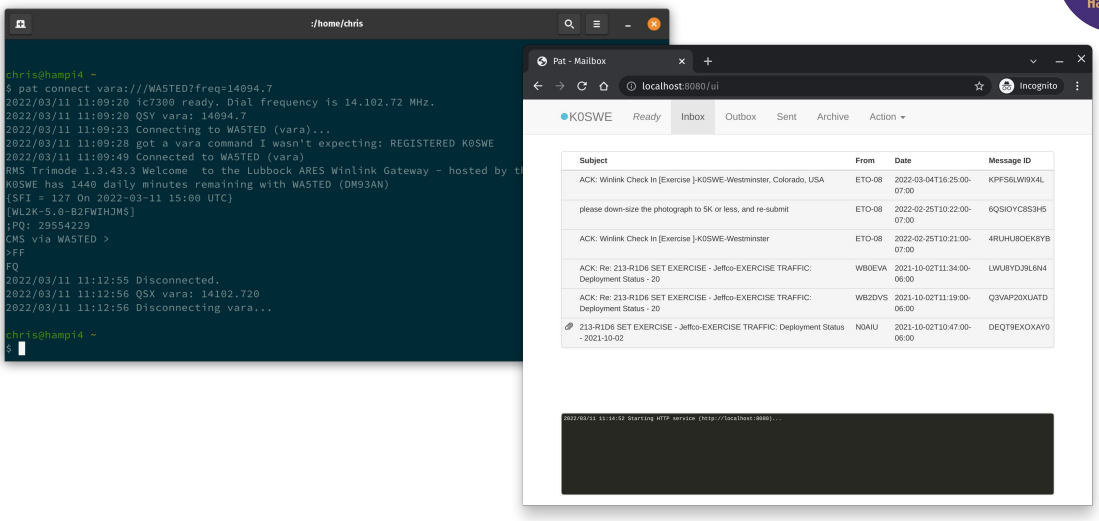
https://getpat.io/

https://github.com/la5nta/pat

Started by Martin Pedersen LA5NTA (Norway) in ~2015. It's open source and built for all major desktop OSs: Windows, Mac, and Linux. Its specialty/niche is Raspberry Pi. I'm one of the contributors/maintainers.

Fun fact: it's named after Postman Pat, a British children's claymation TV series about a mail carrier. Martin was looking for a name that was more "playful" than other Winlink clients.

Pat

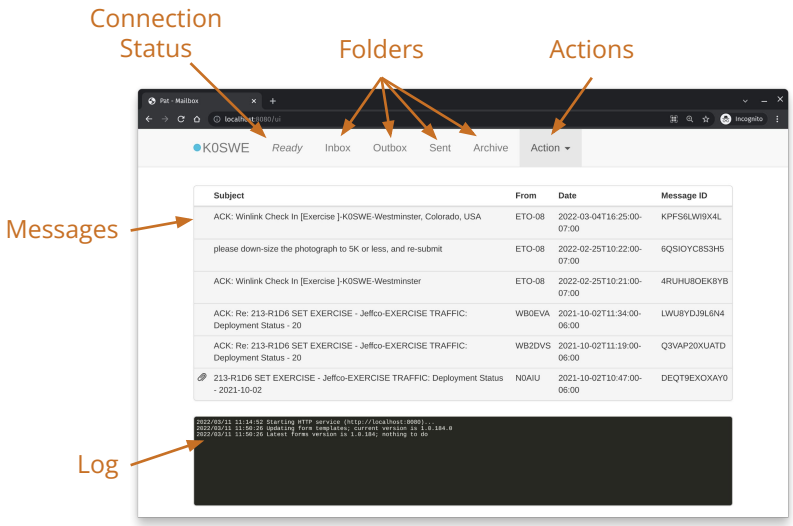


Pat has two user interfaces: command line or locally-served web app.

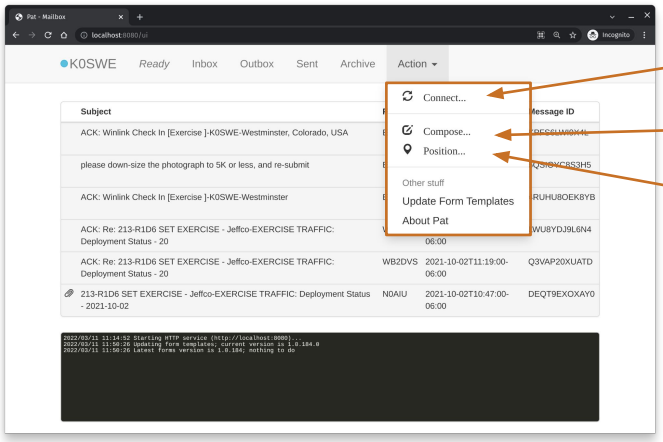
Pat: Installation

Installation is straightforward, and we have pretty robust documentation and community support. https://getpat.io/

Pat Web App


Connection Status
Folders
Actions
Messages
Log
K0SWE
Ready
Inbox
Outbox
Sent
Archive
Action
Subject
From
Date
Message ID
ACK: Winlink Check In [Exercise]-K0SWE-Westminster, Colorado, USA
ETO-08
2022-03-04T16:25:00-07:00
KPFS6LWI9X4L
please down-size the photograph to 5K or less, and re-submit
ETO-08
2022-02-25T10:22:00-07:00
6QSIOYC8S3H5
ACK: Winlink Check In [Exercise]-K0SWE-Westminster
ETO-08
2022-02-25T10:21:00-07:00
4RUHU8OEK8YB
ACK: Re: 213-R1D6 SET EXERCISE - Jeffco-EXERCISE TRAFFIC: Deployment Status - 20
WB0EVA
2021-10-02T11:34:00-06:00
LWU8YDJ9L6N4
ACK: Re: 213-R1D6 SET EXERCISE - Jeffco-EXERCISE TRAFFIC: Deployment Status - 20
WB2DVS
2021-10-02T11:19:00-06:00
Q3VAP20XUATD
213-R1D6 SET EXERCISE - Jeffco-EXERCISE TRAFFIC: Deployment Status - 2021-10-02
N0AIU
2021-10-02T10:47:00-06:00
DEQT9EXOXAY0

Pat Web Actions

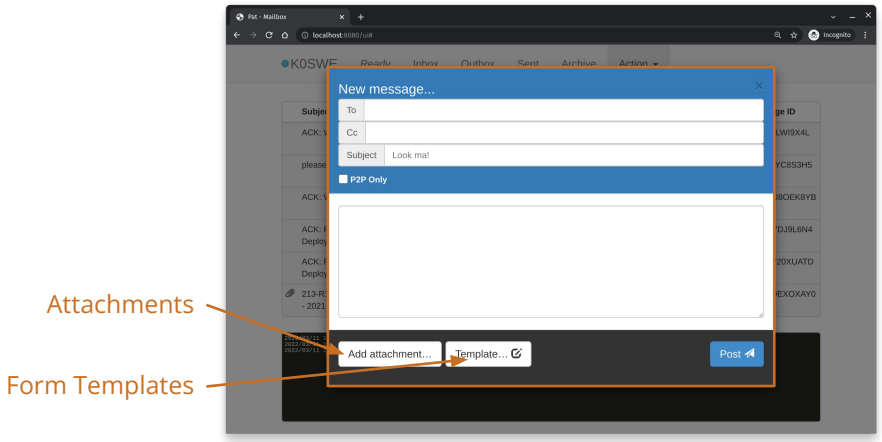


Connect

Compose

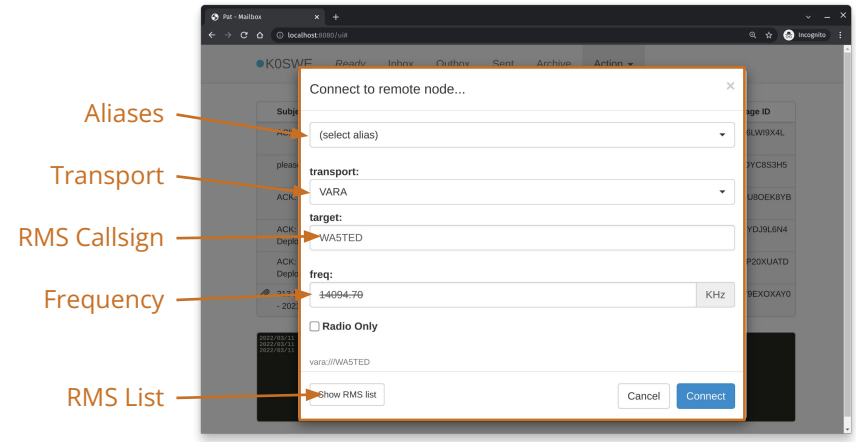
Position Report

Pat Web Compose



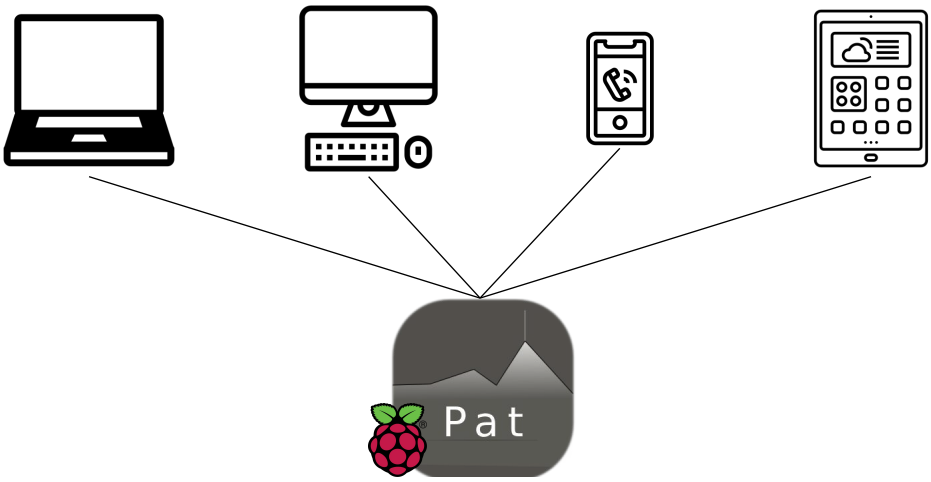
Form templates were a recent addition (July 2021). We still need to add receipt requests, that should happen soon.

Pat Web Connect



If you have rig control (via hamlib) set up, Pat will tune your radio. If not, it will show the frequency struck out.

Multiple Users



One of the really powerful uses of Pat: multiple people viewing the same mailbox. For situations like clubs or Emergency Operations Centers (EOCs), I often hear people wondering about how to maintain continuity between multiple operators on shift, changing across shifts, etc.

Pat can solve this problem by being installed on a computer that stays on-site (maybe a low-cost Raspberry Pi) and plugged into and configured for the radios. It allows operators to access over a LAN using a web browser. Changes to the inbox and outbox are synced real-time so everyone sees the same information, aiding situational awareness.

Useful for served agencies, too, because their personnel can draft their own communications in the web app if desired and leave transmission to the ham operators.

Contact Me

k0swe@arrl.net