

# Next Generation APRS units

## YARA Mobile Communications Unit Trailer

### Functions of the APRS in the Communications Trailer

The APRS unit in the communications trailer is unique in the network and has several functions:

**1) Broadcasts the location of the trailer**

The location of the trailer is used for members to find the trailer when deployed, and provides an added security element in case it is ever moved without permission. In a large emergency exercise or operation any internet connected device would be able to pinpoint the trailer location and coordinate deployment.

**2) Reports telemetry including several voltages and temperatures**

Telemetry informs us if the battery system is compromised to allow servicing before systems become critical, and maintain the trailer at full readiness. It also provides temperatures inside the trailer, usually useful to know when the trailer is in use, as well as CPU core temperature to detect fan failures. In future, other voltages and temperatures may be added as applications are identified.

**3) Provides a map display to show trailer occupants the location of other APRS equipped people and vehicles, and the roads and terrain surrounding the current trailer location**

Useful when using the trailer as a mobile command post during an incident

**4) Provides a method of sending and receiving APRS messages to other APRS users**

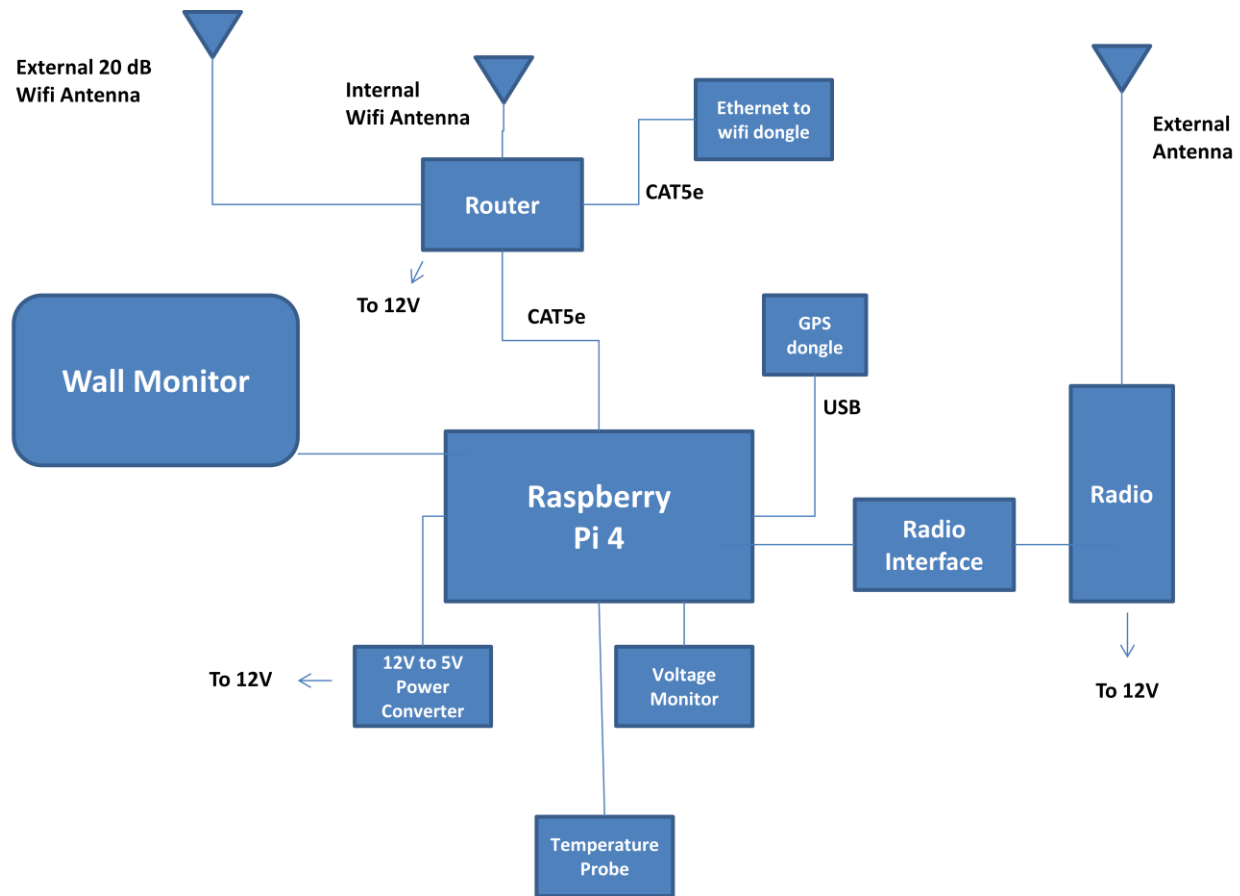
**5) Provides a method of sending short email or text messages to non-APRS users**

Both above items provide a quick reliable communication method when the trailer is away from cell coverage, but within APRS coverage which includes much of the Yukon. Outside cell and APRS areas, Winlink email over HF radio is available at another station in the trailer.

### **NOTE:**

The APRS unit operates at all times and should always be left powered on in the trailer as it is providing important information when the trailer is not occupied. The wall LCD monitor can be powered down when not in use, but the rest of the APRS system should remain constantly powered.

## Trailer System Block Diagram



## What makes up the system Hardware

In the case of the YARA Mobile Communications Trailer, the APRS system consists of a Raspberry Pi 4, a 12V to 5V converter to power it (up to 3A), a UBLOX GPS USB dongle extended to a location outside the metal body of the trailer, a USB soundcard, an interface board between the soundcard and a radio with external PTT input, an ICOM HT-16 transceiver with an external antenna, and a wall mounted monitor connected by a HDMI to VGA adapter. The Pi also has a DS18B20 one-wire temperature probe connected, and an ADS1015 12 bit ADC with support circuitry to measure four voltages at up to 20 V. This will eventually be properly housed, but is floating during this early phase of the deployment.

The Raspberry Pi 4 can be ethernet or wifi connected to the trailer router. This connection can be used to connect to the Pi using VNC software with a smart phone or laptop when it is necessary to interact with the PI software, for example to send a message or similar which will be rare. Because of this it is not necessary to connect a keyboard and mouse except during commissioning, thereby saving some additional desk space.

Note that the router can be configured to provide internet access if the trailer is in a location where wifi is available. A WIFI dongle on the router WAN port provides the connectivity. In this case, with a simple configuration file change, the APRS unit can provide i-gate functionality.

## Component Details

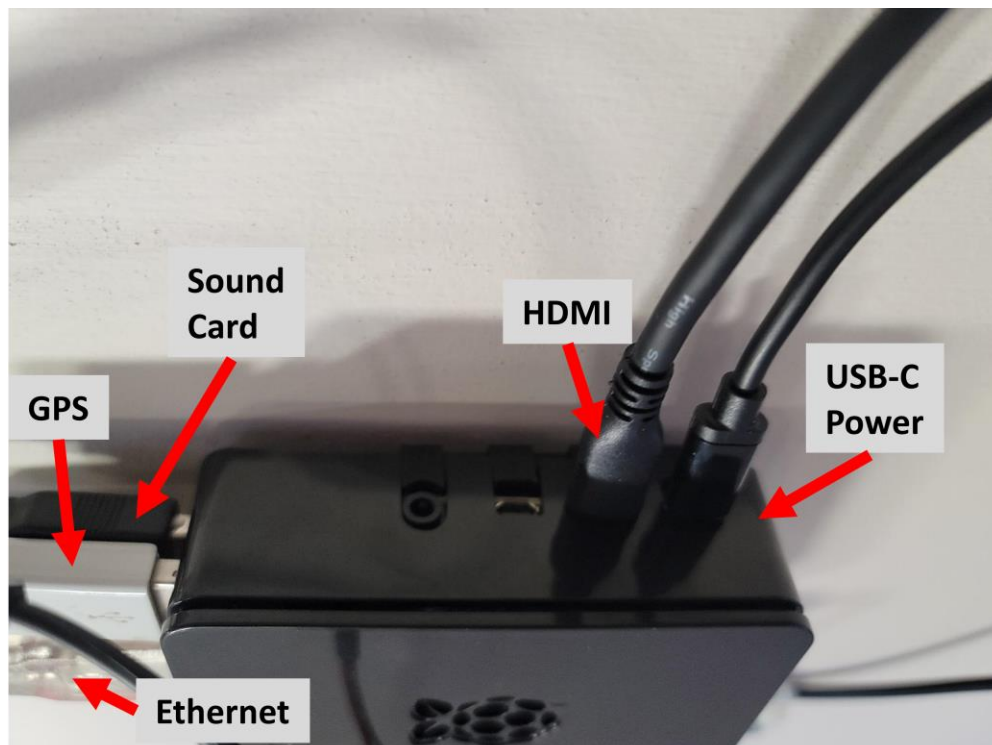
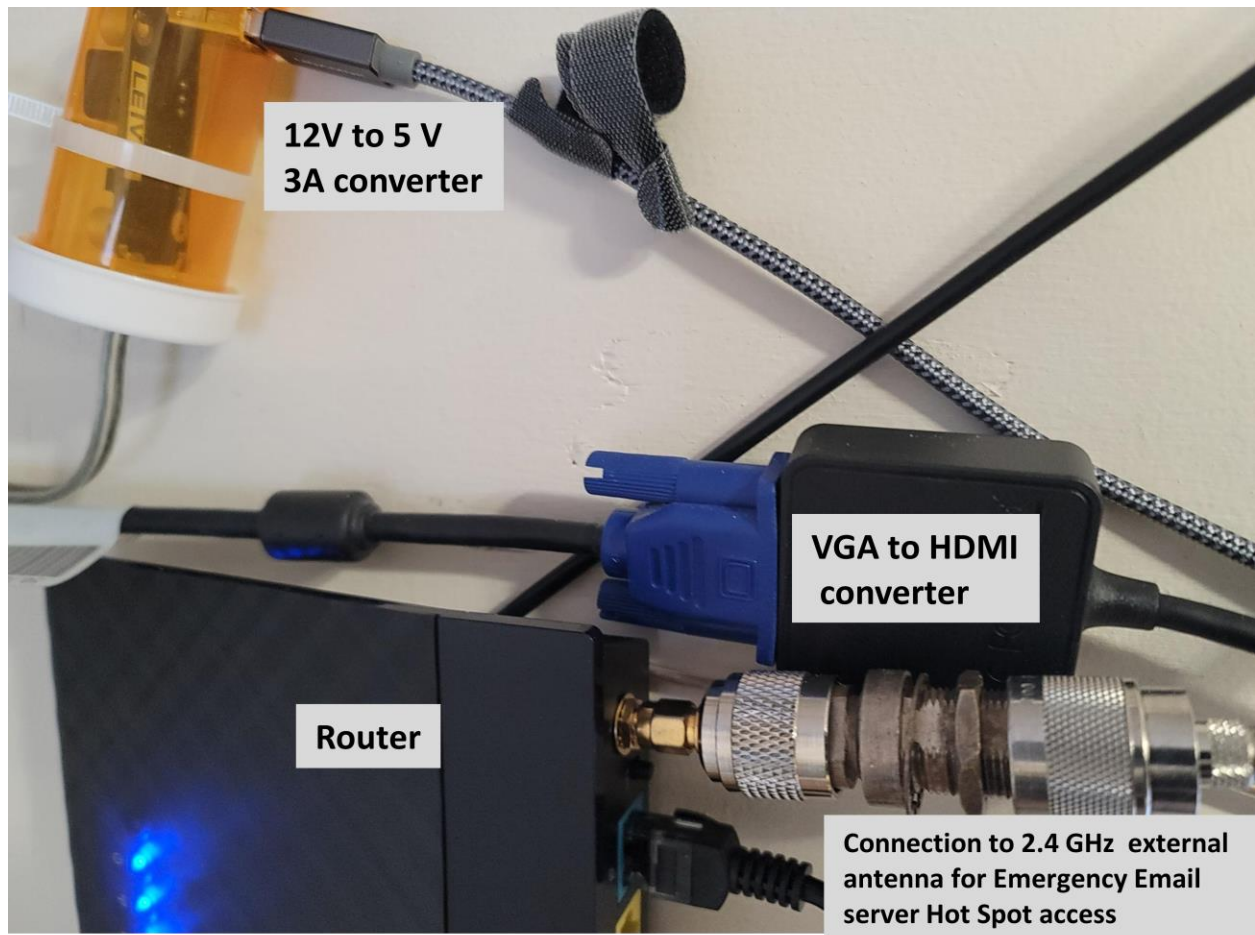
### How does APRS work

APRS works by a local unit exchanging data packets with other APRS units within listening range. When a packet is heard and analyzed, the hearing unit decides if it should be repeated and then repeats the packet if it should, or drops it if it should not. Packets are sent as 1200 baud modem tones modulated on 144.390 MHz (simplex). Packets may contain location information, messages, telemetry, bulletins or even weather information. For a detailed overview, visit here:

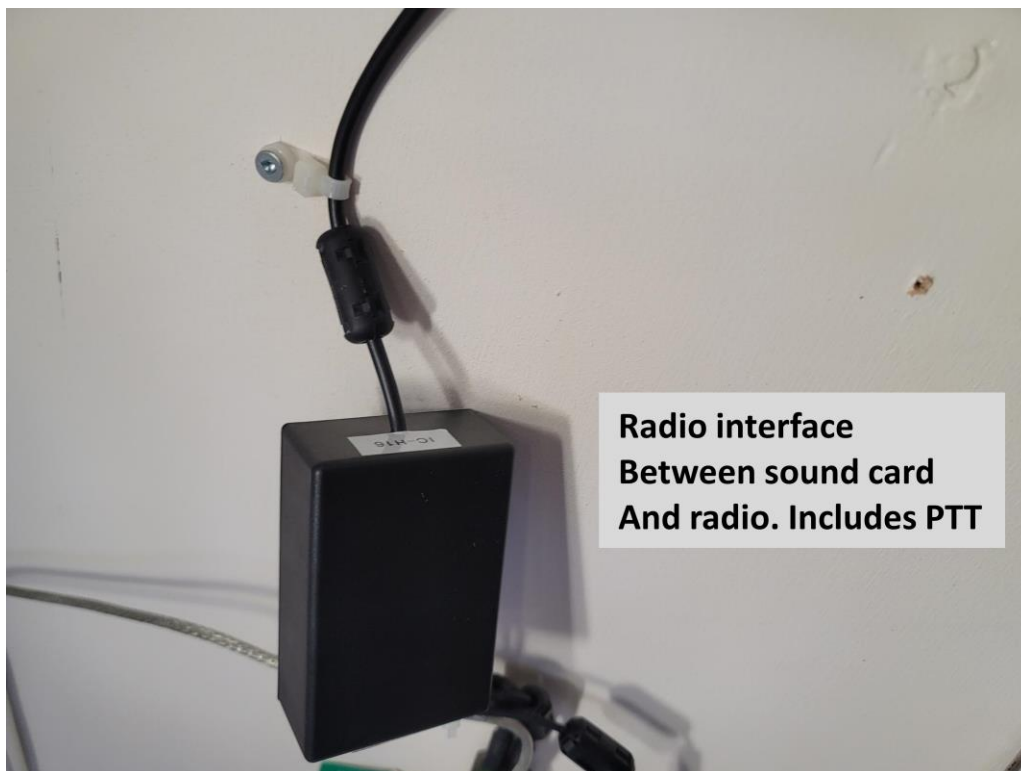
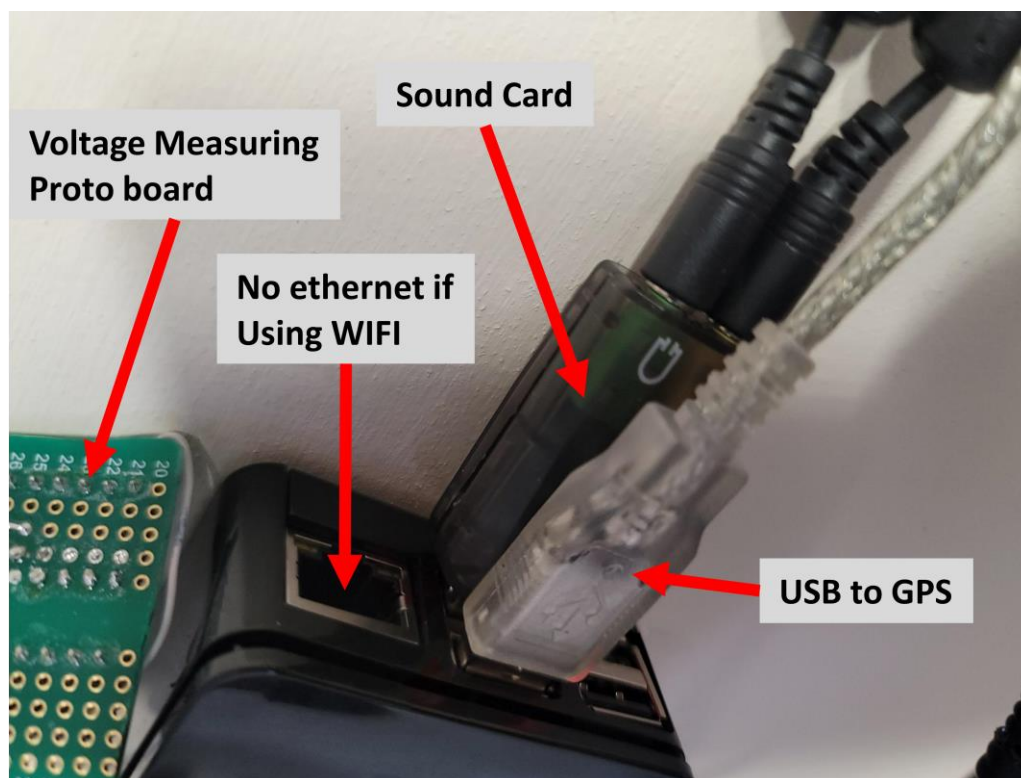
[http://www.philsherrod.com/hamradio/APRS\\_101.pdf](http://www.philsherrod.com/hamradio/APRS_101.pdf) and for the actual specs and other information, visit here: <http://www.aprs.org/>

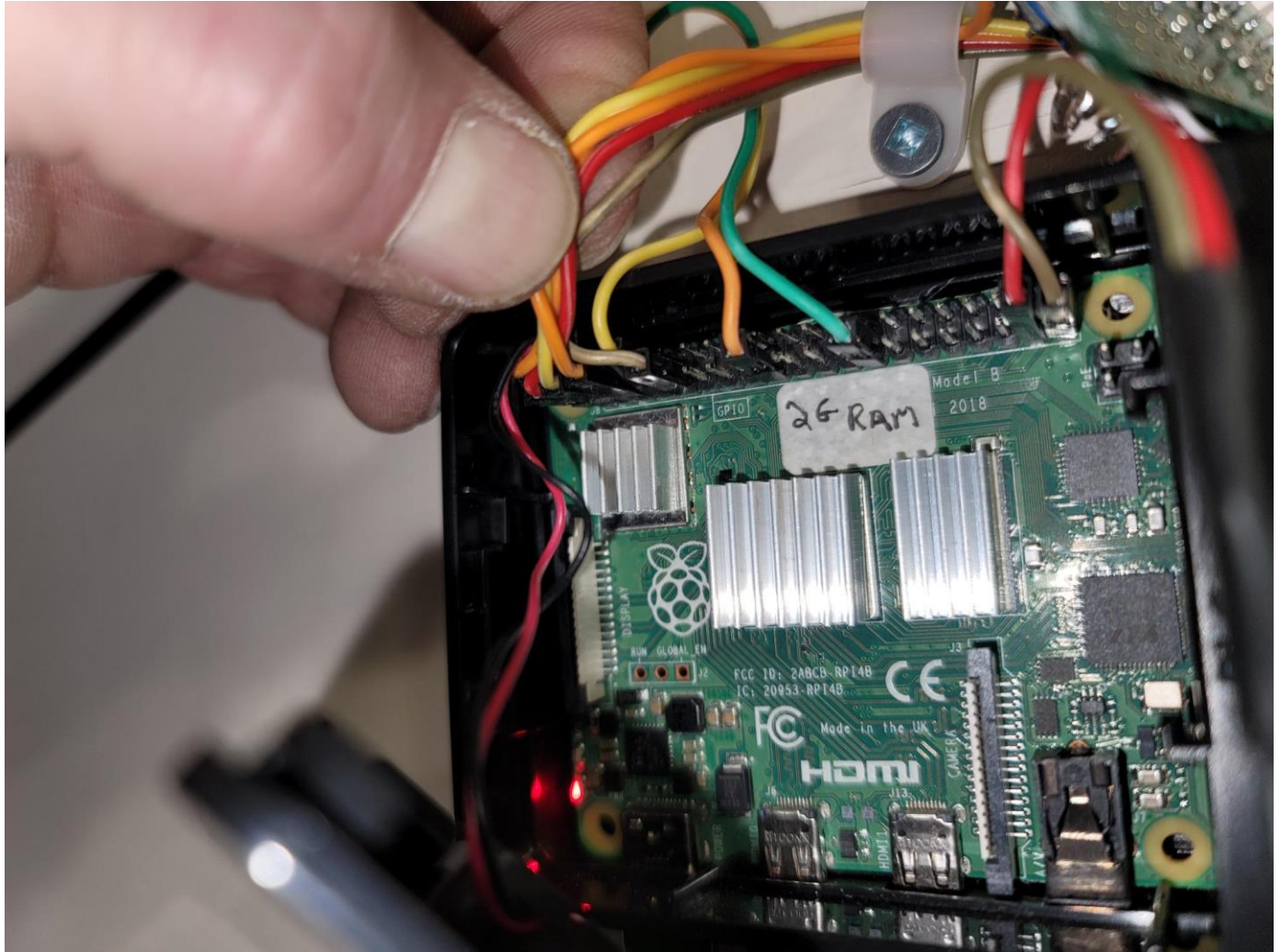
### Photo of the installation with block diagram components labeled







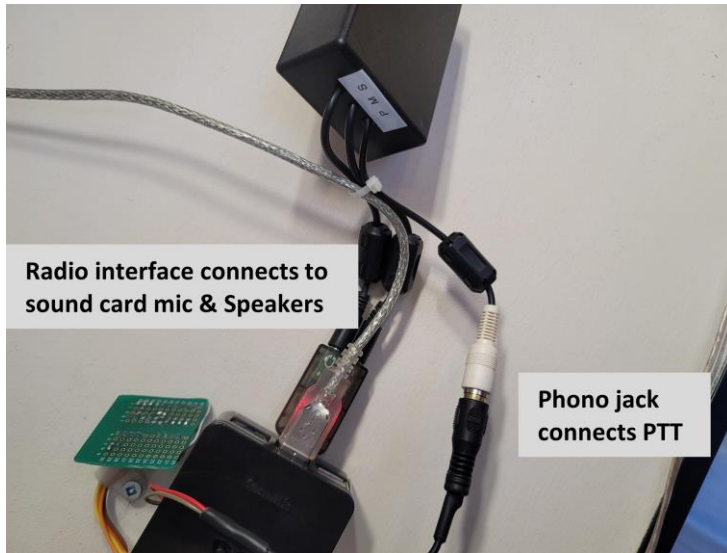




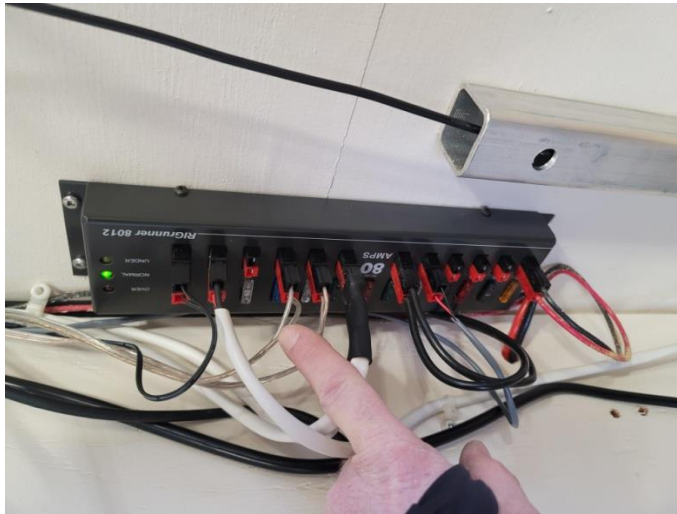
Pins are numbered bottom to top, then left to right.

Bottom left most pin is 1, top left most pin is 2, bottom right most pin is 39, top right most pin is 40.

- The voltage sensor board uses 1 (3.3V - Red) Pin 2(5V-Orange) 3(SDA - Yellow) 5(SCL-Orange) and 9 (GND - Brown)
- The temperature probe uses pins 7(data-Yellow) 17 (3.3V-Orange) and 25 (GND-Green)
- Pin 37 (red) is PTT, and pin 39 (brown) is GND
- Red and black for the fan connect to pins 4 & 6 (+5V, GND) respectively





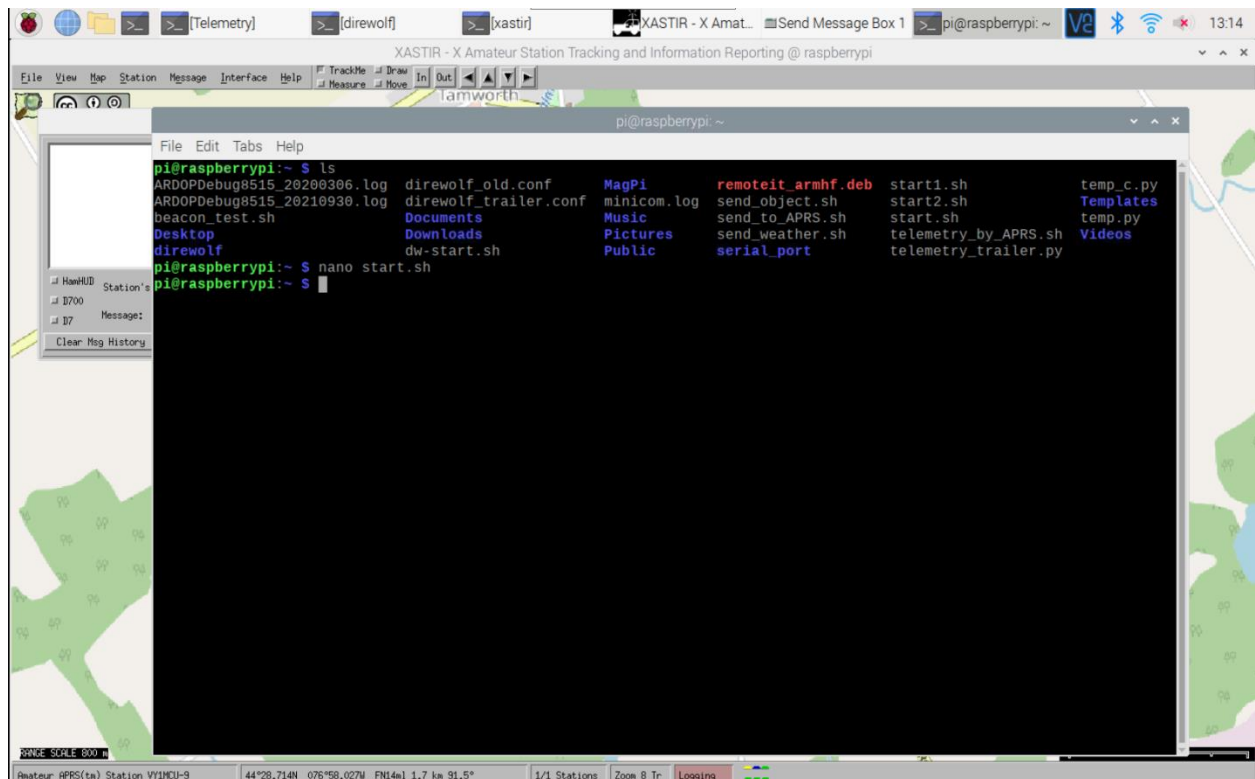


## Power Details

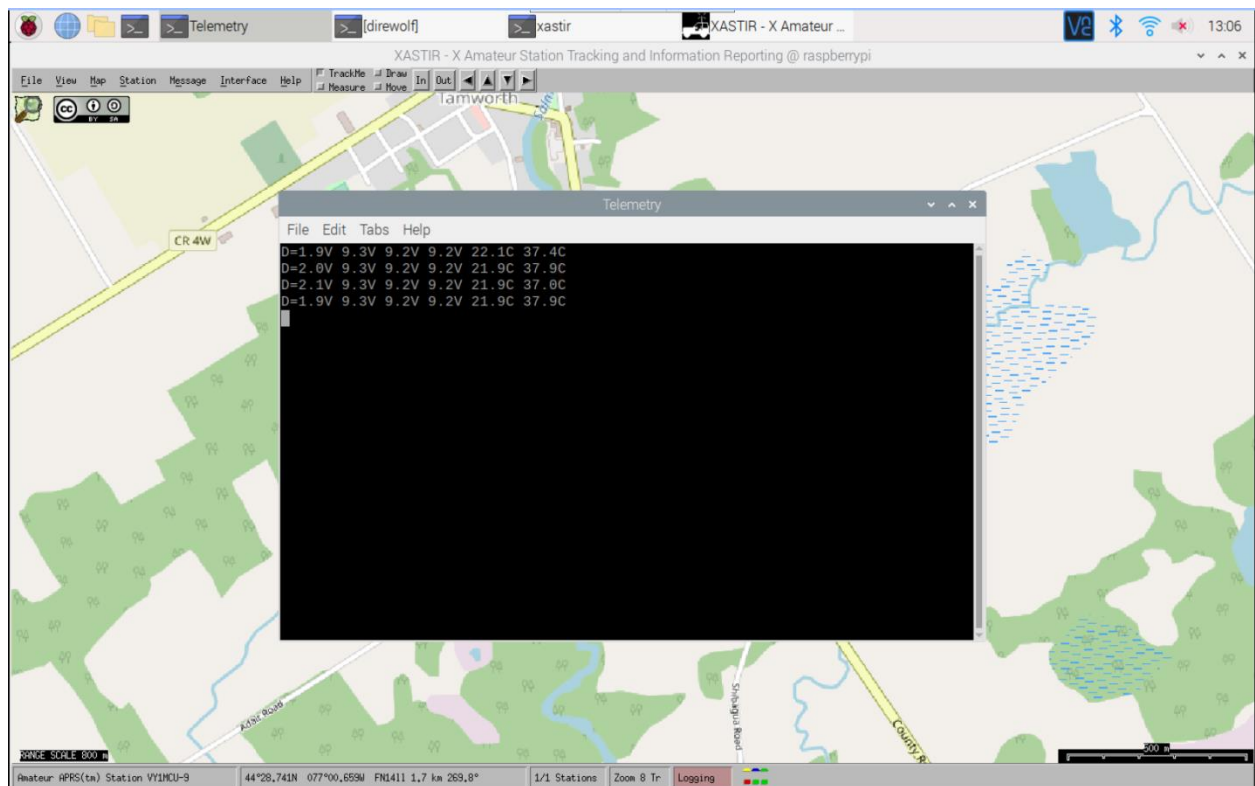


## Software components

The APRS Raspberry Pi uses a collection of free HAM software and a few custom Python programs to provide functionality, and their launch and timing are automated. When first powered up, once basic software is loaded, the “start.sh” bash script is executed. All programs run in their own terminal window, which closes when the program terminates properly or due to an error. Start.sh launches the python telemetry collection program (telemetry\_trailer.py) in a window labeled “Telemetry”. If there is no Telemetry window shown with other terminal sessions at the top of the screen there is a problem – most likely a hardware connection – that needs to be addressed before telemetry data will be collected and sent. “start.sh” also launches “start1.sh” and “start2.sh” concurrently. In the screen shot below, you can see the windows listed along the top of the screen (Telemetry, Direwolf, Xastir, XASTIR-X Amat..., and a window I opened to show you the directory listing of the files needed for the applications.



The first program to launch is Telemetry. When running properly, you can select its window at the top of the screen and see the telemetry data being collected:



“start1.sh” launches “Direwolf” in its own window labeled “Direwolf”. Direwolf provides most of the APRS functionality and can function on its own – for example it is the main application for APRS units used at mountain top repeater sites that have no display. Direwolf filters and decodes packets, beacons information including telemetry, data beacons, packet repeating, etc. and behaves like a TNC for other applications. All of the control parameters for Direwolf are set in the “Direwolf.conf” file located in the /home/pi directory (default). If no Direwolf window is open, the most likely cause is the USB soundcard is not plugged in properly. For details on making changes to Direwolf, including the direwolf.conf file, please consult the Direwolf user guide, available online.

Direwolf displays in its window packets that are sent and received, and decodes them to human readable form. Colours indicate the type of information being displayed.

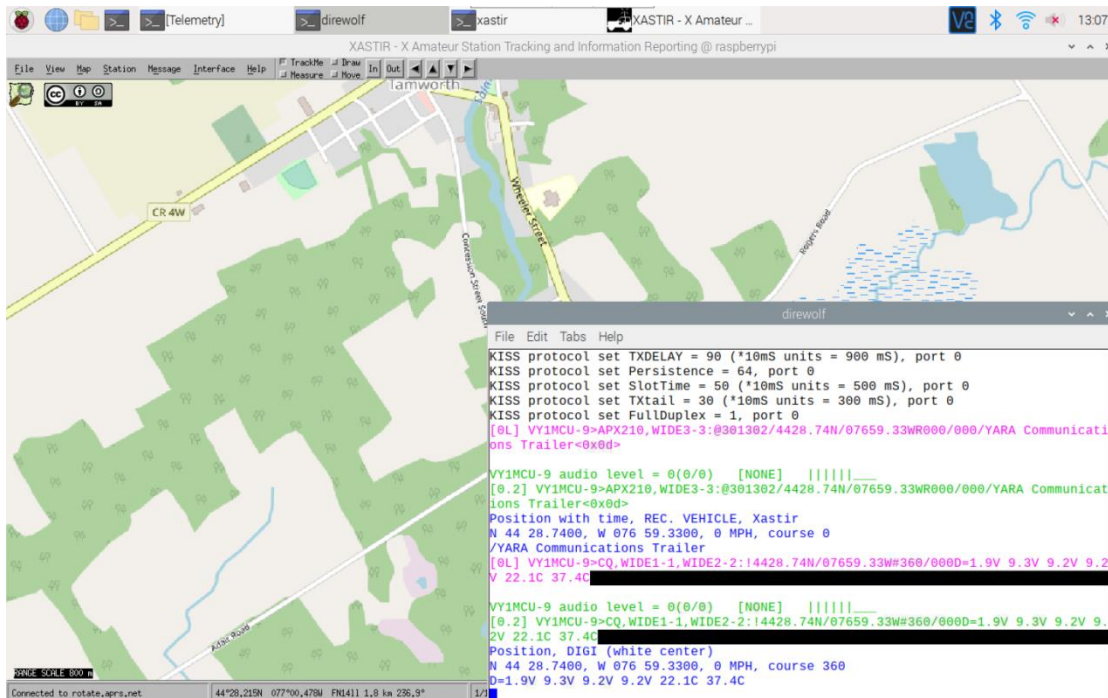
Black = information and status messages

Purple = what is being sent

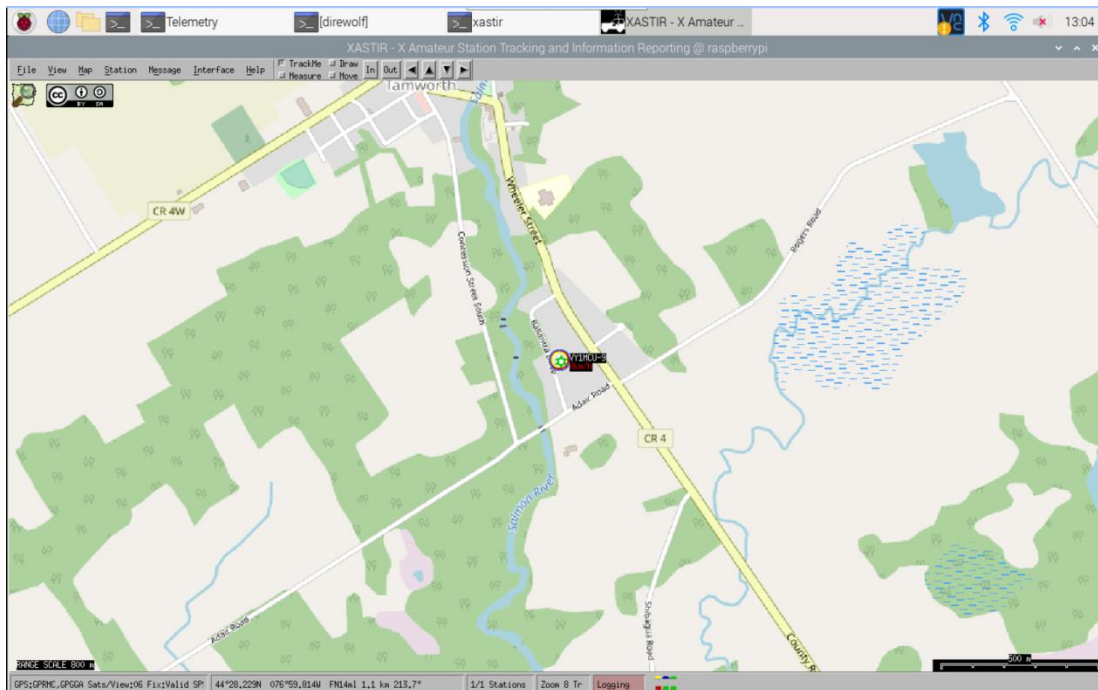
Green = what is being received on the radio

Blue = the message decoded

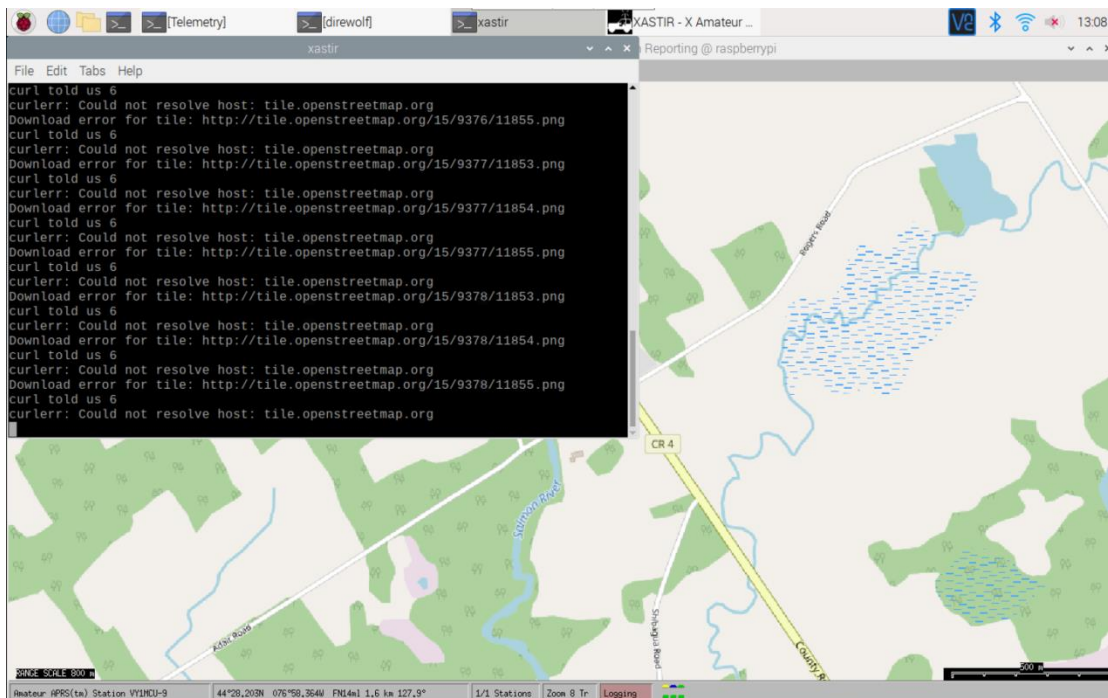
Red = errors. This could include bad form messages being sent by other users (none shown in the example below:



“Start2.sh” launches Xastir in its own window. Xastir provides the location display, mapping, APRS messaging reception and composition. It has local map content, although it is still bring expanded to provide offline maps for all of the Yukon and Northern BC where the trailer is most likely to be deployed. This is the normal view on power up. For details on using Xastir, please consult the online user guide.



Once completely running there should be 4 tabs showing along the top of the screen. Telemetry, Direwolf, Xastir, and Xastir-X.Amateur... Xastir has 2 tabs, one for the display that is the main view, the other is a text window that convey messages to the user. For example:



If any of the tabs is missing, the first check should be all connections, then a complete shutdown and reboot. Do not use the power button to shut down, but rather connect to the Pi, click on the Raspberry in the upper left with a mouse, then choose shutdown, then reboot or shutdown. Shutdown will require a power cycle to restart, reboot restarts automatically.

## **How do you use the APRS System**

The APRS unit is autonomous and requires no intervention. However there are a few things a user may wish to interact with:

Changing the map scale

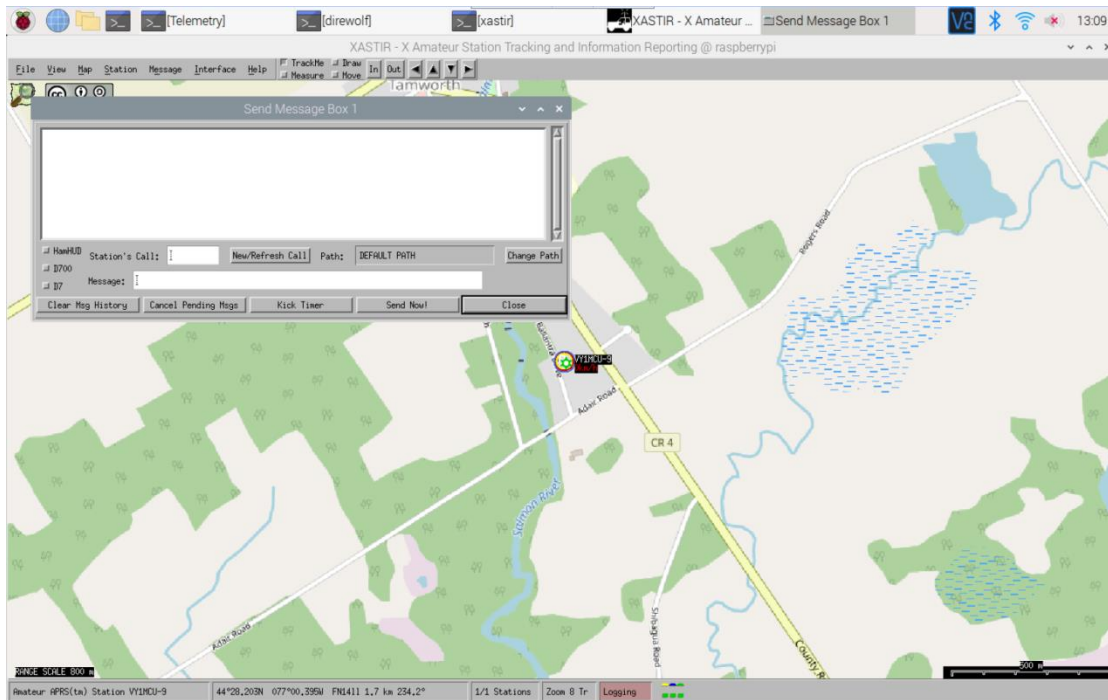
Replying to a message

Creating a new message or bulletin

These items are covered in the Xastir manual.



Here is an example screenshot of creating an APRS message to someone:



Note that sending an APRS message to SMSGTE can send a text to a phone number. The text should begin with the "@" symbol followed by the phone number— example @8673322313 Hi Charlie. Text limit is 67 characters including the number.

## **Connecting to the Pi by VNC**

If you wish to connect to the PI for remote control and display, you may do so with VNC. VNC has clients for Android, IOS, Microsoft Windows, Linux, and other platforms. Download the app on your platform of choice. To use your device, first connect to the trailer network. To use the trailer wifi, use the following:

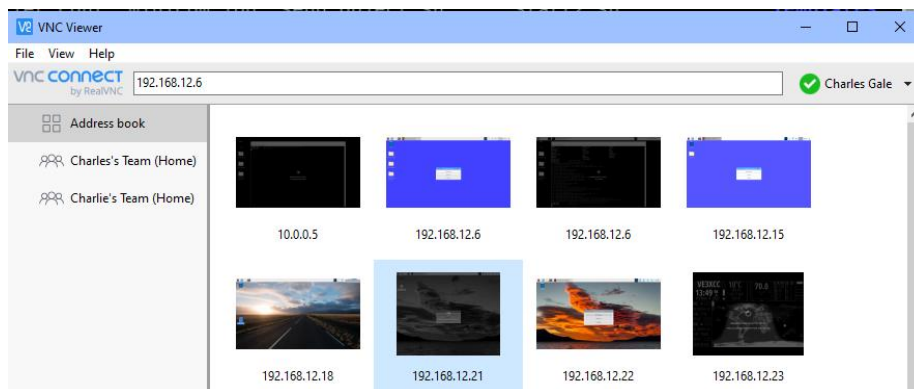
Wireless network: YARAtailer

Wireless network password: YARAtailer

Note: The network and password are configured to be the same. If the network is showing a different name, use that name as the password.

Once connected, determine the Raspberry Pi address. You can do this by logging into the router at 192.168.0.1 password admin

Then to connect to the pi, launch the VNC application.



Type in the address of the pi. If it finds the pi it will prompt for username and password:

Username: pi

Password: YARAtailer

When this is done correctly, you will be rewarded with a screen that is identical to the screen on the wall. You can then use your mouse, keyboard, or touch screen to interact with the programs on the pi.

### **Not in the Comms Trailer, but you have an Internet Connection?**

1. Find the trailer location – Go to <https://aprs.fi>. Search for VY1MCU-9
2. Telemetry information – Go to the YARA website. [http://yara.ca/repeater\\_status/repeaters.htm](http://yara.ca/repeater_status/repeaters.htm)
3. Send an APRS text message - <http://www.findu.com/cgi-bin/entermsg.cgi>