Radio & Programming Clinic

Silvercreek Amateur Radio Association

Today's Agenda

- Basics of FM radio communications

- Repeater operations and etiquette

- General programming techniques using the keypad

- Programming cables

- CHIRP software

Basics of FM Two-Way Radio

Section 1

FM Radio Communication Types

Simplex - Refers to bi-directional communication on a single frequency

Duplex – Bi-directional communication where transmissions occur on one frequency and are re-broadcast or repeated onto a separate receive frequency
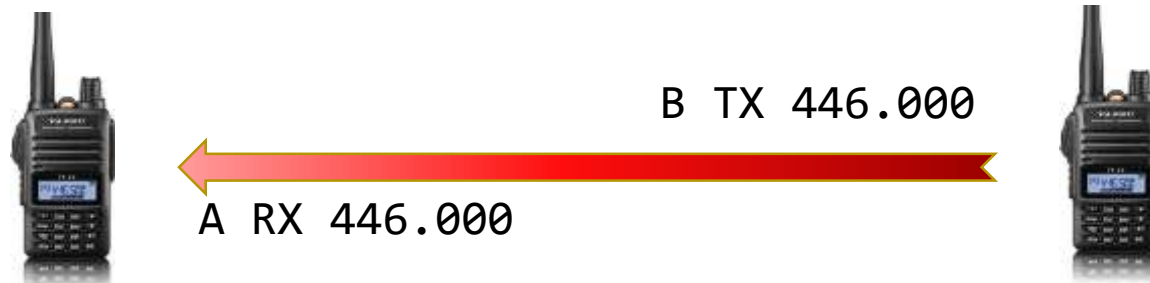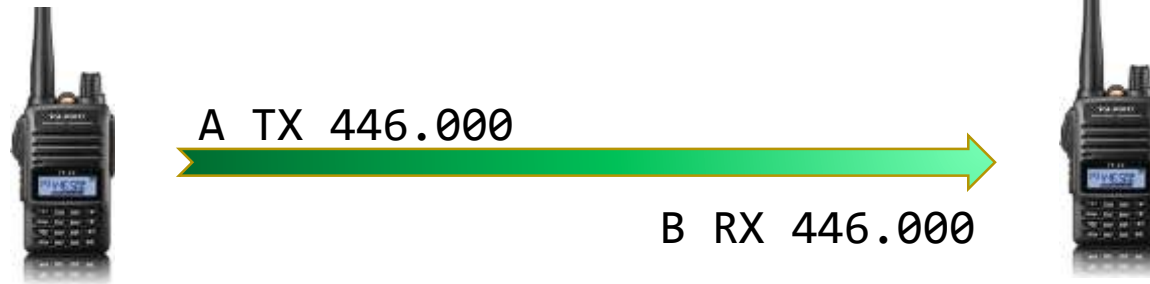
Simplex Communication

In simplex communication, two radios are set to the same frequency and one radio receives the transmission of the other.

Uses of simplex:

• Point-to-point or "line of sight" radio communications

• Certain types of "hotspots" such as Allstar, DMR, or D-Star

Simplex Communication

A TX 446.000

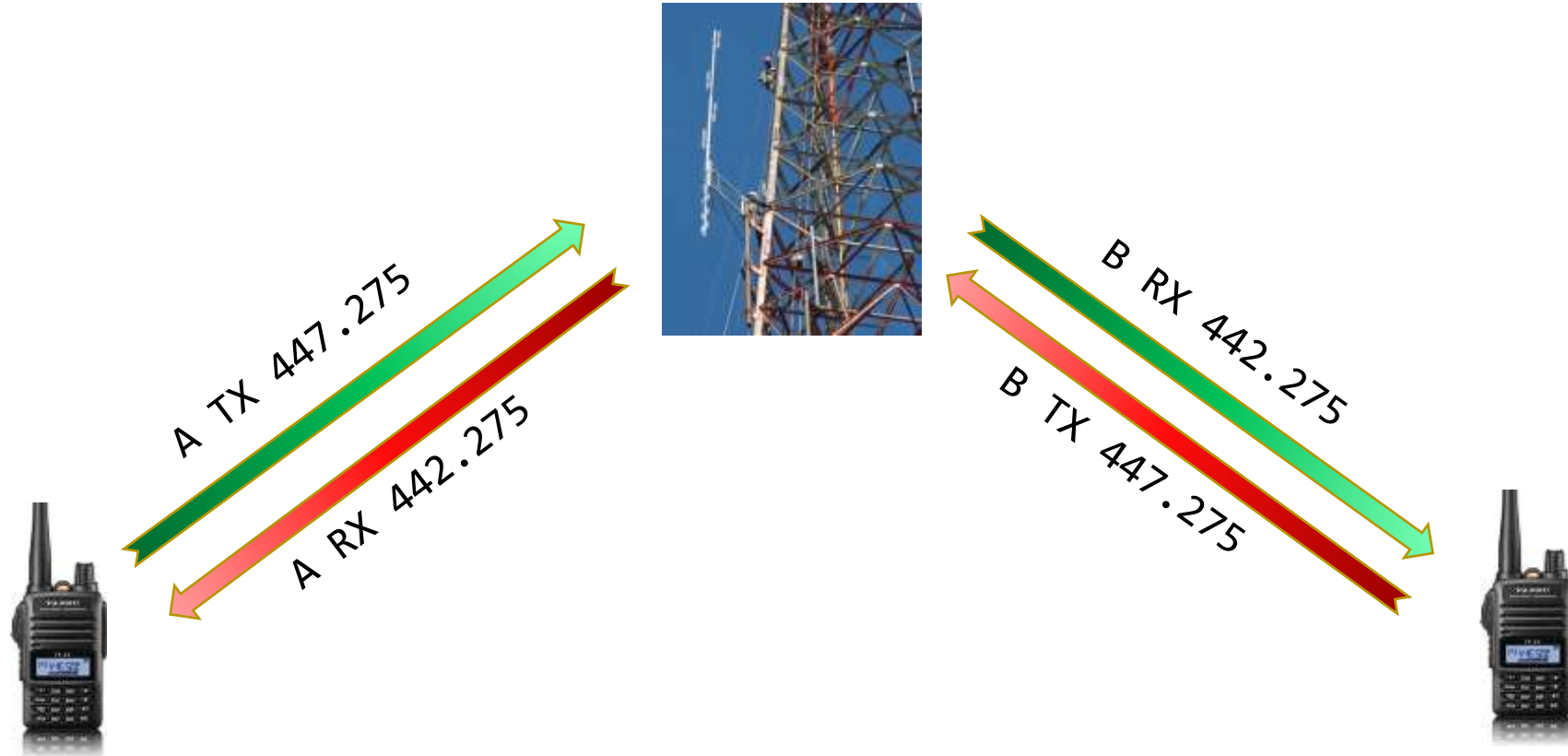B RX 446.000

B TX 446.000

A RX 446.000

Duplex Communication

In duplex communication, all reception is done on one frequency while all transmission is done on another frequency.

Uses of duplex:

- FM repeaters of all types

- Working "split" communications – often found in contesting

Duplex + Repeater Communication

A TX 447.275

A RX 442.275

B RX 442.275

B TX 447.275

Frequency Selections

The ARRL defines the "bandplan" for each band.

Where repeaters are common, certain frequencies are set aside for inputs and output.

Other frequencies are set aside for "simplex" communication

Frequency Selection

2m Frequencies for FM

- 144.90 – 145.10 FM Simplex

- 145.20 – 145.50 FM Repeaters

- 145.80 – 146.00 Satellite

- 146.40 – 146.58 FM Simplex

- 146.61 – 146.97 FM Repeaters

- 147.00 – 147.39 FM Repeaters

- 147.42 – 147.57 FM Simplex

- 147.60 – 148.00 FM Repeaters

70cm Frequencies

- 435.00 – 438.00 Satellite

- 442.00 – 445.00 FM Repeaters

- 445.00 – 447.00 FM Simplex

- 447.00 – 450.00 FM Repeaters

Frequency Selection

2m Frequencies for FM

- 144.90 – 145.10 FM Simplex
- 145.20 – 145.50 FM Repeaters
- 145.80 – 146.00 Satellite
- 146.40 – 146.58 FM Simplex
- 146.61 – 146.97 FM Repeaters
- 147.00 – 147.39 FM Repeaters
- 147.42 – 147.57 FM Simplex
- 147.60 – 148.00 FM Repeaters

70cm Frequencies

- 435.00 – 438.00 Satellite
- 442.00 – 445.00 FM Repeaters
- 445.00 – 447.00 FM Simplex
- 447.00 – 450.00 FM Repeaters

- Do Not use Satellite bands for simplex or hotspots
- Even if you can't hear activity!

Frequency Selection - Repeaters

Offsets are defined in band plans. Repeater frequencies are listed by their <u>output</u> frequency and the input is inferred from the offset.

- 2m is +/- 600 kHz depending on frequency
  - Example: RX – 147.390 MHz, TX – 147.990 MHz

- 70cm is +5 MHz or -5 MHz depending on which *output* frequency is listed
  - Example: RX – 442.275 MHz, TX – 447.275 MHz
  - Example: RX – 447.275 MHz, TX – 442.275 MHz

Some high-density areas will have non-standard splits but are usually well-publicized when they occur.

Frequency Selection - Repeaters

Standard offsets are pre-defined in most radios

- 2m
    - Nationwide standard outlined in the ARRL Band Plan
    - 145.200 - 145.500 has –600 kHz offset
    - 146.610 - 146.970 has -600 kHz offset
    - 147.000 - 147.390 has +600 kHz offset

- 70cm
    - "Local Option" defined in the ARRL Band Plan so you have to check
    - Ohio has output low, input high. California, for example, does it backwards.
    - 442.000 – 445.000 output has +5Mhz offset input
    - 447.000 – 450.000 output has -5Mhz offset input

Frequency Selection – Coordinated Repeaters

§ 97.3 Definitions.

(a) The definitions of terms ...

(22) Frequency coordinator. An entity, recognized in a local or regional area by amateur operators whose stations are eligible to be auxiliary or repeater stations, that recommends transmit/receive channels and associated operating and technical parameters for such stations in order to avoid or minimize potential interference.

§ 97.205 Repeater station.

(c) Where the transmissions of a repeater cause harmful interference to another repeater, the two station licensees are equally and fully responsible for resolving the interference unless the operation of one station is recommended by a frequency coordinator and the operation of the other station is not. In that case, the licensee of the non-coordinated repeater has primary responsibility to resolve the interference.

Coordination in Ohio is performed by the Ohio Area Repeater Council (OARC)

Real-Life Example: Importance of Bandplans & Coordination

Recently W8WKY 147.390 was having a problem with noise for users to the north. Something on the input was "pushing" frequencies out of band and causing capture effect in the receiver.

Was determined to be an Allstar "hotspot" simplex node with good coverage located in Brunswick. The simplex node was using 147.995 Mhz (the input to 147.390 is 147.990) which violated our 15 kHz channel spacing.

Since SARA's repeater is coordinated through OARC, FCC rules state that the uncoordinated interfering party is required to resolve the interference. The person had to move their node to a different frequency.

CTCSS / PL "Tone"

Adds a low frequency, usually inaudible, tone to voice communications used to signal the receiver to open its squelch rather that rely on a "strong enough" "good" signal.

CTCSS – Continual Tone-Coded Squelch System
PL – Private Line (Motorola brand name)

These are the <u>same</u> thing and the acronyms are used interchangeably!

All FM radios since the mid-90s support CTCSS/PL

Standardized set of tones

CTCSS / PL "Tone"

OARC defines "standard" tones for each region but it's just a recommendation:

Region	Suggested CTCSS/PL
NW	67.0, 85.4, 107.2, 156.7, 186.2, 218.1
NE	69.3, 88.5, 110.9, 131.8, 162.2, 192.8, 225.7
SE	74.4, 91.5, 114.8, 167.9, 203.5, 229.1
SW	77.0, 94.8, 118.8, 123.0, 173.8, 206.5, 233.6
Central	71.9, 82.5, 97.4, 151.4, 179.9, 210.7, 241.8

Most area repeaters use 110.9 and 131.8

Not always though! For example W8WKY on 147.390 uses a "non-standard" PL 114.8 for historical reasons and changing it would be very hard.

Repeater CTCSS/PL Output – TSQL

Some repeaters will also (re)transmit a PL tone out to the receiving radios. This can be used in the same way the repeater does to open the squelch.

- If website, repeater book, etc. doesn't specifically say there's an "output" or "downlink" or "sent" tone, don't assume it has one and set TSQL – you'll never hear the machine! If you can't quickly test before programming, don't set your radio to TSQL for that memory.

- Some repeaters will only partially transmit tone back out. For example, N8XPK 147.135 and 444.200 will send downlink tone for RF repeats but not for courtesy tones, telemetry, Allstar, Echolink, etc. due to hardware limitations. In these cases, you likely don't want TSQL.

CTCSS / PL "Tone"

Sometimes, CTCSS is used to "select" an input based on geography.

Example - Summit Co. ARES W8ODJ has three area repeaters for input coverage from HTs:

- All repeaters transmit on 444.550

- Akron repeater receives on 449.550 PL 131.8

- Norton repeater receives on 449.550 PL 88.5

- Green repeater receives on 449.550 PL 225.7

Allows user to select best receiving location and not open up the others to repeat a poor signal.

Digital Coded Squelch (DCS)

Designed as a replacement for CTCSS. Rather than encoding a constant tone, encodes a digital bit stream in the audio. Provides more "codes" to keep comms separate in a commercial environment.

Goes by other names:

- Continuous Digital-Coded Squelch System (CDCSS)
- Digital Private Line (DPL) - Motorola
- Digital Channel Guard (DCG) - GE
- Digital Tone Code Squelch (DTCS) – Icom

Not widely used in this area. Used occasionally in very dense areas like Orange County in California.

A really nice option for simplex communications in areas with lots of activity.

Radio Types

- ## Handhelds or "HT"
  - Portability

- ## Mobile
  - Vehicles or the shack
  - Many used in good shape

- ## Base Stations
  - 2m and 70cm is rare
  - Only useful or cost-effective if you want to do CW or SSB on 2m and 70cm

Radio Selection Basics

HTs trade portability for performance:

- Unless you are very close, an HT won't get into repeaters (well) from inside your QTH

- You can add an external antenna to HTs

- Don't take it personally when you're trying to get into a repeater with your HT and others say you have a bad signal – the radio can only do so much

Thoughts on Baofengs

Baofeng UV-5R is a common first radio for new hams

- Incredible price point

- Not very clean transmission

- Quality is uneven

- Audio level is often very low
  - Consider enlarging the mic hole

Don't let other hams make you
feel bad about owning and using
one! Conversely, don't take it personally when people say you have bad or
low audio.

Antenna Basics

Remember VHF/UHF is all about line-of-sight

• Higher is always better

• Dirt, trees, structures – all block VHF/UHF

The "rubber duck" on your HT is probably the worst possible antenna after literally no antenna.

Transmitting with your HT on your belt and a speaker/mic is even worse. Just don't.

An inexpensive, well-performing home station can be constructed with an HT, a modest outdoor antenna, and some appropriate feedline

Antenna Basics

Look around your QTH for ideas

- Porch, deck, or pergola roof

- Unused satellite dish mount

- Trees are probably not a good solution for 2m/70cm VHF/UHF unless you only need to transmit in one compass direction

At minimum put a magmount on your car – HTs do not work well in cars. Magmounts have very flexible feedlines that can feed through the door or trunk seals onto the roof.

Some Components to Consider
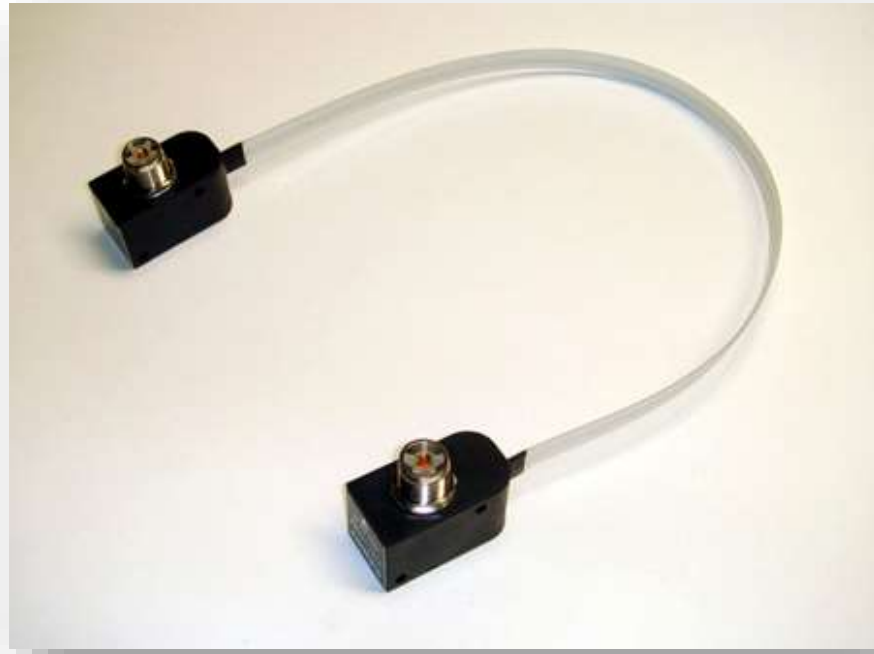
Comet CTC-50M – Flat ribbon door and window pass-through for HF, VHF, UHF ($50)

MFJ-1729 ($35)

Good Transmit Audio Matters

Proper mobile/portable microphone use:

- Hold the microphone or HT 1"-2" from your mouth
  - Closer can lead to distortion
  - Farther makes you hard to hear

- Talk across the mic/radio, not directly into it
  - Talking into the mic can lead to loud breath and pop sounds for the listeners

- Speak in a normal voice

- Listen to others, do you want to sound like them? Mimic what the good ones sound like.

Good Transmit Audio Matters

Don't be afraid to ask people how your audio sounds, especially with a new radio

If you're a Broadcastify.com subscriber, you can access recordings of traffic on 147.39 and hear yourself

• Broadcastify is delayed about 20-30 seconds, so you can usually hear yourself after you stop transmitting even without a subscription

On noisy signals, low audio is much harder to understand

Many HT's have especially low transmit audio, you must compensate

• Many radios have a *microphone gain* adjustment in the menus or programming software

When programming your radio, **do not select** FM-N or Narrow mode for your channels

Repeater Operations and Etiquette

Section 2

Finding Repeaters

- repeaterbook.com

- RepeaterBook app for iOS, Android, Amazon Kindle

- Club websites

- SARA's local repeater curated list

- RFinder

- ARRL Repeater

Using Repeaters

Before you key up, listen for existing traffic.

If no one is talking...

- "This is CALLSIGN listening"
- Do not call CQ on a repeater

If people are talking..

- Consider if it's appropriate to interrupt the QSO
- In a gap between transmissions, just state your callsign
- Do not say "break" – that implies emergency traffic

In all cases, give yourself a one second pause before you start talking after you key up. Most repeaters need a little bit of time to decode the PL and open the squelch.

Using Repeaters

Types of conversation on repeaters:

- Two person QSO

- Roundtable

- Controlled Net

Using Repeaters

For two person QSOs and roundtables:

- Don't timeout the repeater
  - Most repeaters will stop transmission and lock out after 3 or 4 minutes depending on configuration
  - If your turn will take longer than three minutes
    - State you need to "pause for time" or "get a minute"
    - Unkey and wait for the courtesy tone or the squelch to close
    - Key up and keep going – you don't need to resend your callsign unless it's been 10 minutes and then you have other issues...

- "Fast key" is poor amateur practice. Leave gaps between transmissions so others can get a word in or break in for an emergency.

Using Repeaters - Nets

A radio net is a formal gathering of hams to communicate for a stated purpose.

- The Net Control Operator directs all traffic. Wait your turn to transmit.

- Don't interrupt a net in progress – unless it's an emergency. Wait for net control to call for additional check-ins.

- Almost all nets are open to all licensed amateurs so don't be afraid to check-in to one.

  - Exception – don't check in to a traffic handling net unless you're versed on how traffic handling works

  - Exception – don't check-in to or interrupt an ARES response or exercise net unless it's an emergency

Other Repeater Etiquette

Repeaters often ID every ~ 10 minutes

In most cases, you can key up over the ID audio and it's suppressed or goes into the background as CW.

Don't forget to follow FCC Part 97 rules on transmitting your ID. The repeater ID is not fulfilling your ID responsibility!

Allstar

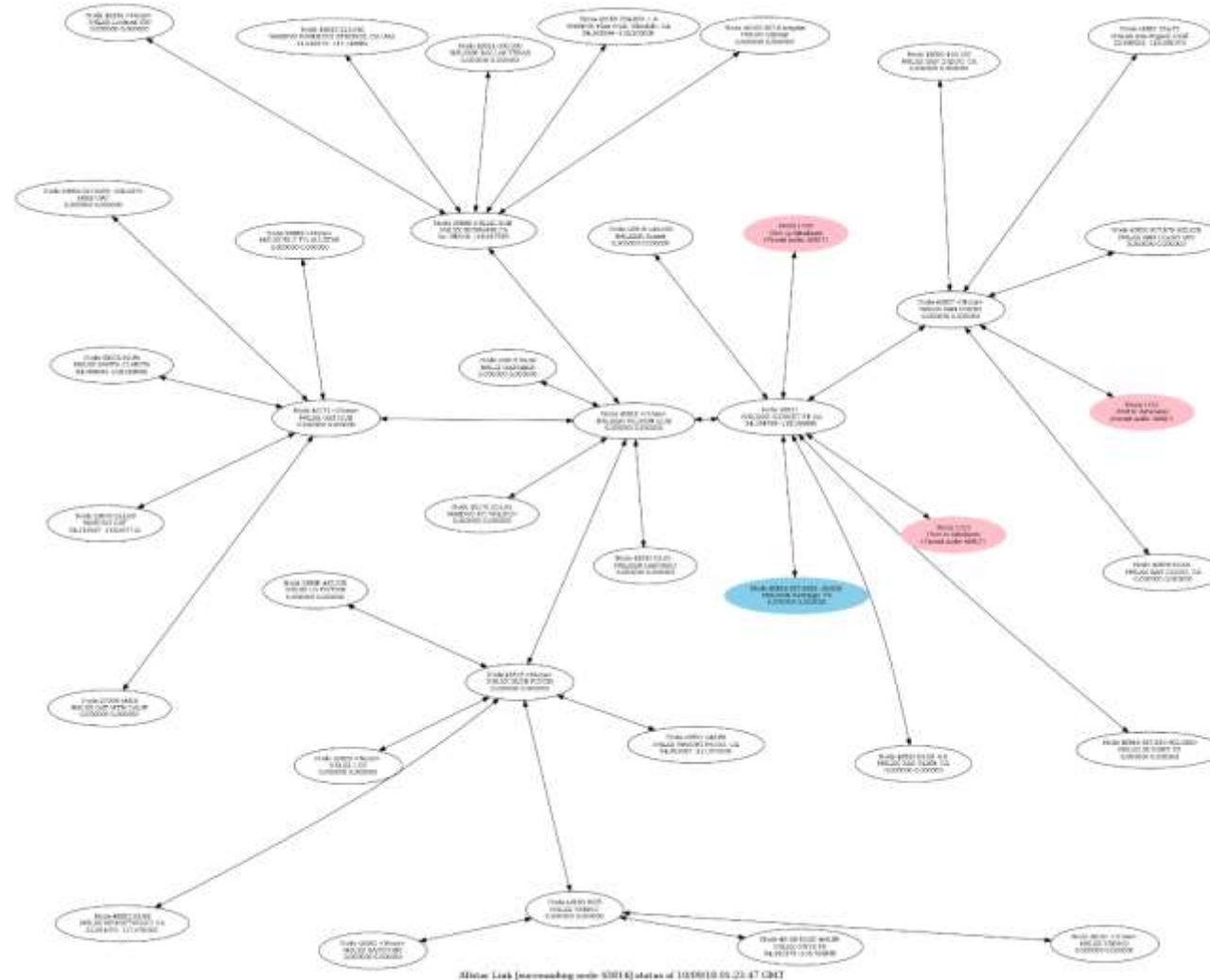Allstar is a method of interconnecting repeater systems using Internet linking.

- Built upon the Asterisk PBX software for telephony

- Allows standard analog FM radios to transmit over linked repeaters

- More info: allstarlink.org

A number of area repeaters are Allstar-enabled:

W8WKY - 147.390, W8WKY - 442.275,
WW8TF - 442.375, N8XPK - 444.200

Look for Allstar-enabled repeaters in repeaterbook.com or at stats.allstarlink.org

Large Allstar Network Example (33 Nodes)

Megalink Network in Akron

Node 42757 442.7375+
WW8TF Rittman, OH
40.983105 -81.794136

Node 43258 442.375+
WW8TF West Rittman OH
40.980740 -81.800959

Node 48496 The.Megalink.Network
WW8TF In the Cloud
40.098937 -83.122108

Node 43078 442.275
W8WKY Doylestown OH
40.985892 -81.694787

Node 46018 442.5125+
N8JDM Norton, OH, USA
41.057491 -81.684244
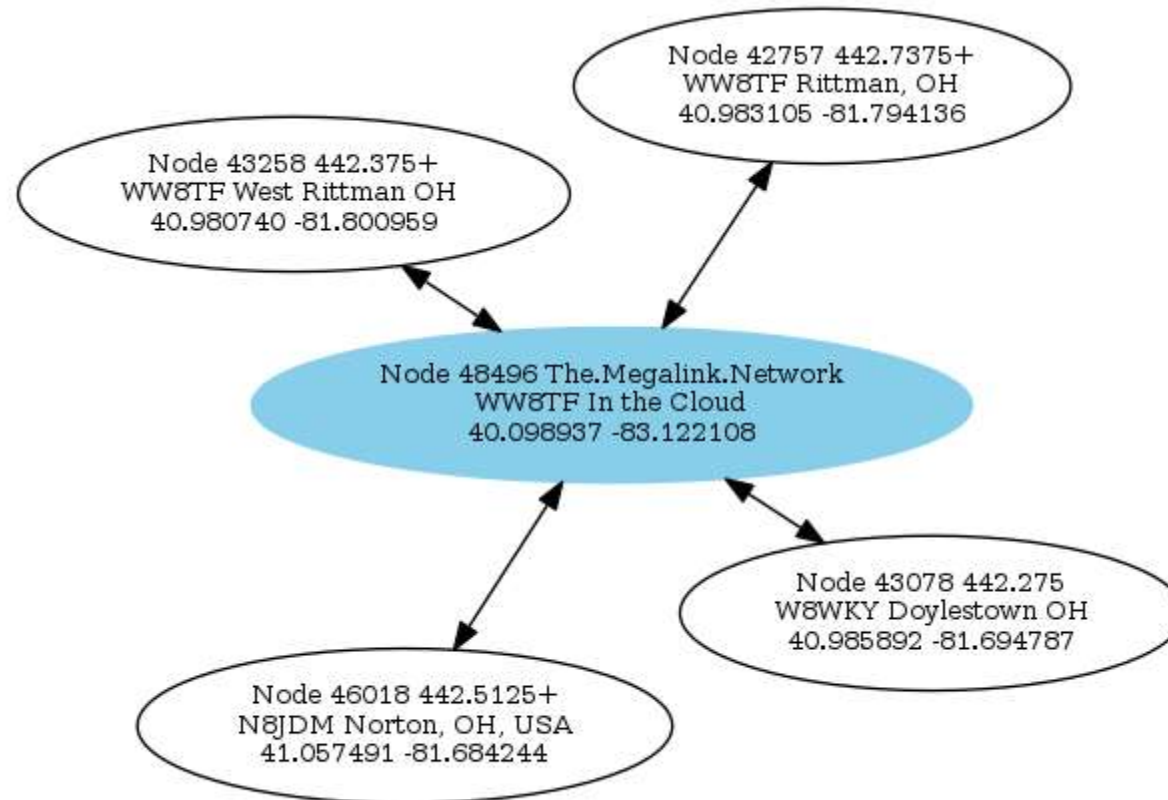
Allstar Link [surrounding node 48496] status of 10/09/18 01:41:37 GMT

Allstar Basic Operations

Basic operations controlled by DTMF Tone

Code	Purpose
*70	List all nodes currently connected to the repeater. Do this before performing other linking operations.
*2 <NODE>	Connect the current repeater to node <NODE> in monitor/listen-only mode. Example: *248496 would connect the local repeater to Allstar node 48496 in listen-only mode to the Megalink Network hub.
*3 <NODE>	Connect the current repeater to node <NODE> in transceive mode. Example: *348496 does the same as above except in tranceieve (i.e. full communications)
*0 <NODE>	Disconnect the connected node <NODE> for either *2 or *3 operations
*75	List all nodes connected across the whole topology. Don't run this on big networks.

Echolink

Echolink is a multi-platform software that uses a "software" radio on a computer or phone to transmit and receive from repeaters or other Echolink systems

- Still requires an FCC amateur license

- Has a number of problems and quirks

- Enables hams who have moved, travel, or no longer have RF equipment to keep in touch.

Some local repeaters support Echolink:

W8WKY-R (147.390), WW8TF-R (442.375), N8XPK-R (53.17)

Echolink

Very finicky software to make work reliably

In most cases, you will need to connect with a "Proxy". Set this up in your client settings. Otherwise, you have to port-forward a port in your router to your machine which gets ugly quick

Echolink has a significant lag in the audio. Imperative to listen first and get the tempo of a QSO before jumping in or you'll talk over someone.

Echolink does not perform well on marginal cell connections. If you think you have a marginal cell connection, ask for a signal report before you start into a long chat.

Intermission

We will start up again in precisely five minutes....

Programming from the Keypad

Section 3

Keypad Programming Basics

Almost all radios with a keypad and VFO can be programmed from the front in the following general manner:

1. Set the VFO to the frequency to receive

2. If programming a repeater, ensure the offset is configured correctly – recall most radios have built-in offset logic for the standard bandplan

3. Set your CTCSS or DCS type and tone/code

4. Store the VFO into a memory slot

5. Name the memory slot on supported radios

CTCSS Gotcha

Some radios allow the CTCSS Tone (what you send) and TSQL (what you receive) to be different values. On these types of radios you must always program both, even if the Tone and TSQL are the same.

Example: Many Icoms support different values for Tone and TSQL. Icom options name the tone sent the "rt", presumably for "Repeater Tone". The tone received to open the squelch is named "Ct" for ???

Programming an Icom IC-207

https://youtu.be/oDKGFXQRY7g

Programming a Yaesu FT-60R

https://youtu.be/VtSvpBnsROY

Programming a Yaesu FT-60R Alpha on Memory

https://youtu.be/hJfwUra9L7o

Programming Cables

Section 4

Radios Use Serial, Computers Do Not

- Most radios use some form of serial communications to be programmed.

- When was the last time you saw a new computer with a serial port on it?

- USB to Serial TTL chips are used

  - FTDI chips are the gold standard

  - Silicon Labs CP2102 are also a good choice

  - Prolific is <u>rarely</u> a good choice

- RT Systems makes good cables but they only work with the RT Systems software.

Warning about Prolific-Based Cable Chips
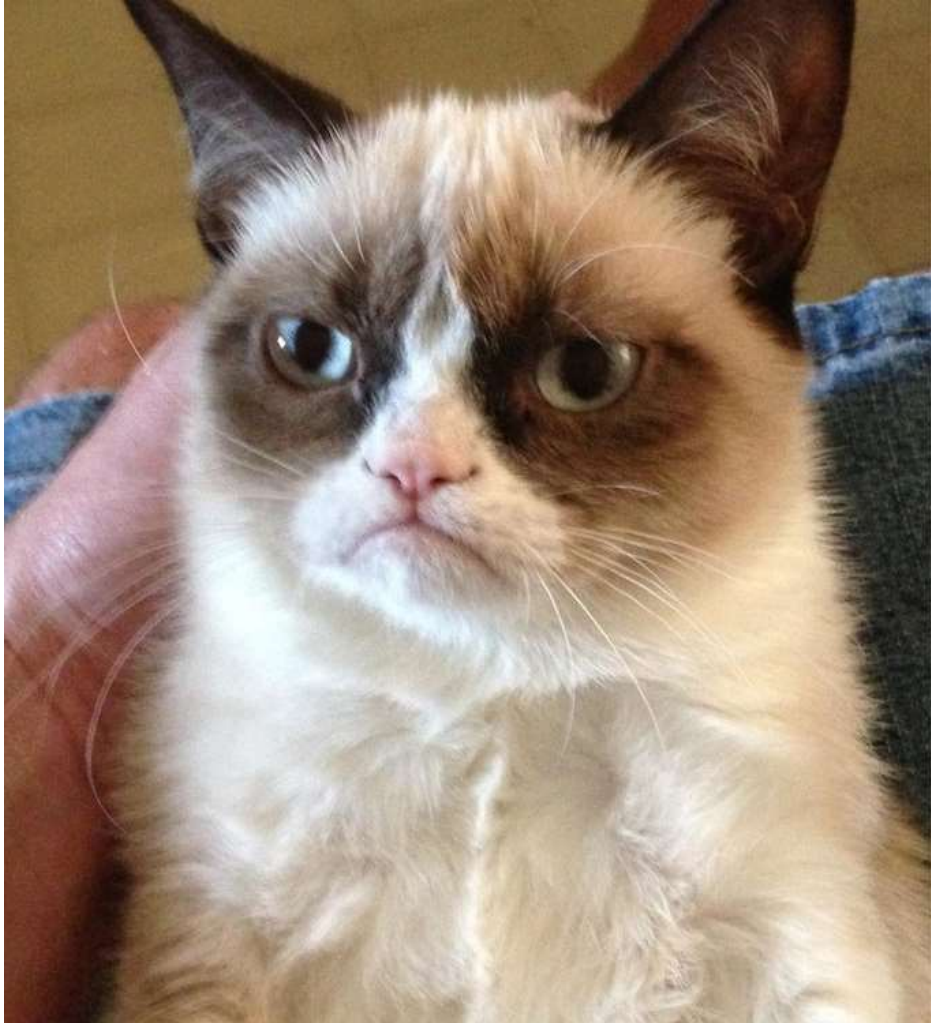
THIS IS HOW YOU WILL FEEL IF YOU BUY A PROGRAMMING CABLE THAT HAS A PROLIFIC USB TO SERIAL CHIP IN IT.

Seriously, don't buy them! They have serious compatibility problems with Windows 7/8/10 and many have problems on MacOS and Linux as well!

How do I Know if it's a Bad Prolific?

- If the cable costs less than $15 <u>regardless</u>

  - Some sellers are putting "FTDI" in the title of the cable to try to scam people.

- Product page says it's "stable" or "efficient" or "not cheap" – it's likely none of those things.

- The product page says it works great… once you install the provided driver.

- The product page is written in very poor English or the product ships "Direct from China"

1 Pin USB Programming Cable for Radio Yaesu FT-60R ███████ RT40 Vertex VX-2R VX-3R VX-5R Two Way Radio (1 Pack)
by ███████
Be the first to review this item
Price: $12.99 ✓prime

Product description

Features:
Super stable and efficient
Easy to use without wasting time
Working exactly as expected once install the driver
Very durable and not cheaply made

Good Cables and Chips

- All reputable cable makers will specifically state what chip they are using – FTDI, CP2102, or "Genuine Prolific" and will offer a no-questions-asked return. See **bluemax49ers** on eBay as an example.

- Sometimes you get lucky – N8JDM has a Prolific-based cable for his FT-8900 that happened to be genuine and works great in Windows 10.

- If you want to build your own cable, get a Silicon Labs CP2102 USB to TTL on eBay.

Programming with CHIRP

Section 5

CHIRP

CHIRP is a free, open-source tool for programming your amateur radio. It supports a large number of manufacturers and models, as well as provides a way to interface with multiple data sources and formats.

https://chirp.danplanet.com/
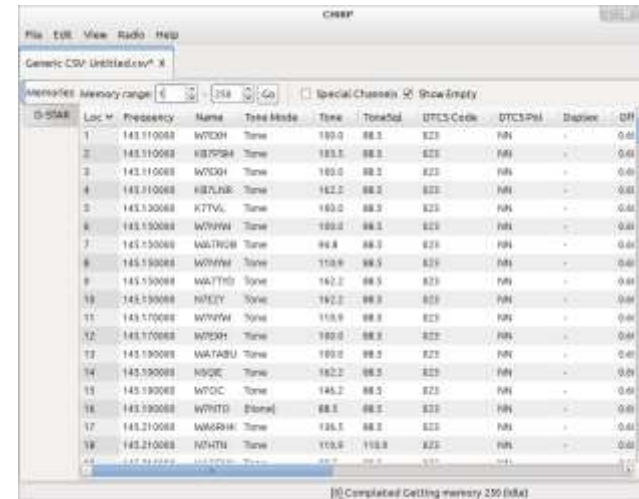
Setting Up Chirp

1. Download and Install Chirp

2. ~~???~~

3. PROGRAM!

Seriously, there is nothing to configure in CHIRP.

Determine the Cable Port

Windows 10

- **Plug in the cable**

- **Open the *Device Manager* utility**

- **Open the top level item**

- **Open *Ports (COM & LPT)***

- **Note the "COM" port number**
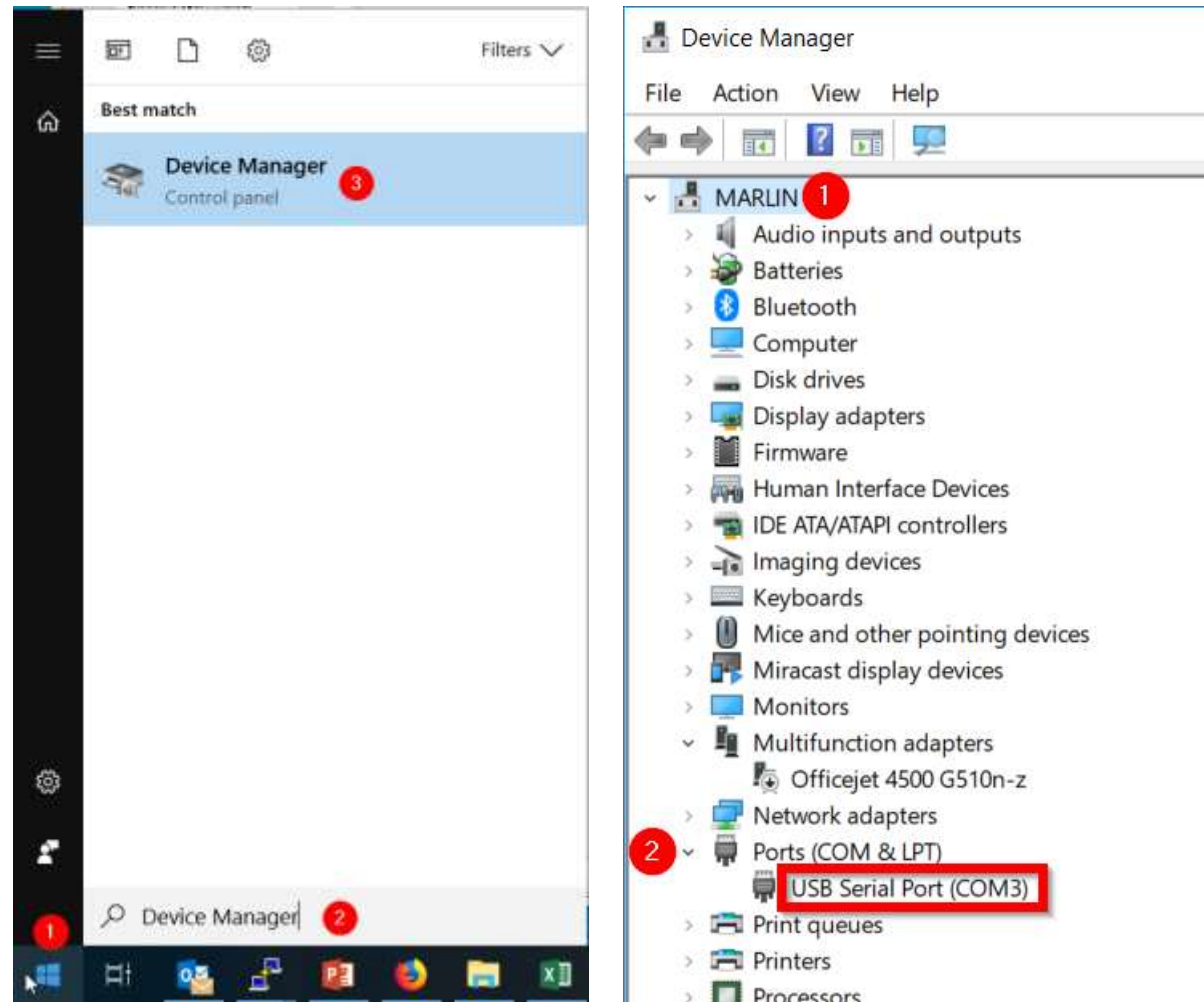
Determine the Cable Port

MacOS

- **Plug in the cable**

- **Open Chirp**

- **Radio...**
  - **Download**

- **Normally will have two ports listed**
  - **Bluetooth**
  - **Your serial cable as /dev/cu.usbserial**
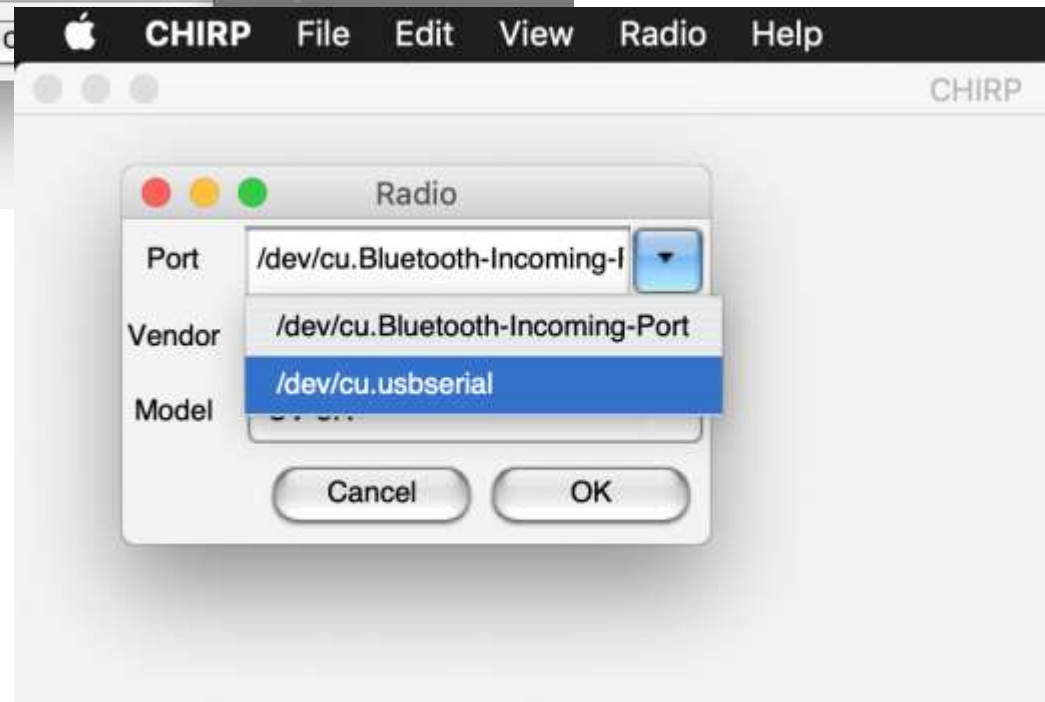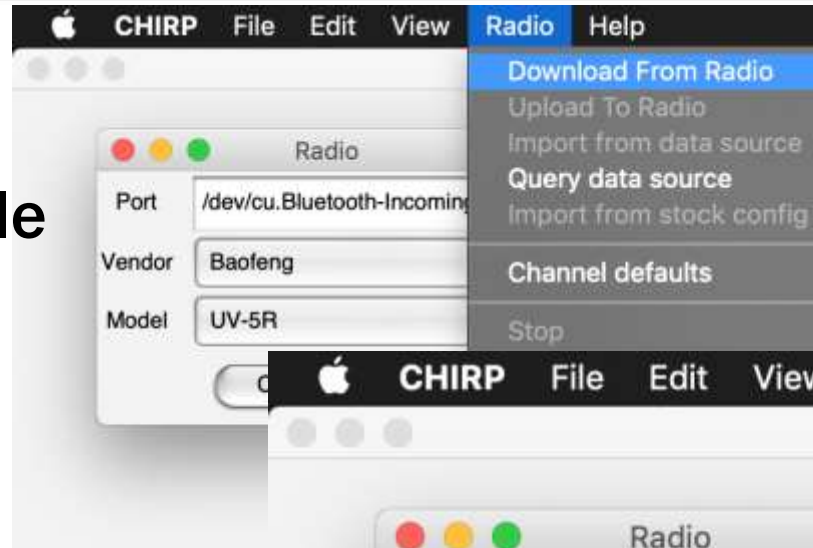
Basic CHIRP Steps to Programming

1. Download the current program for the radio – even if it's blank! You need a base image from the radio.

2. Import program items as needed

3. Edit the program items as desired

4. Write the program back to the radio

Download Program from Radio

https://youtu.be/pSc7ZYtfO9k

Deleting Existing Programmed Memories

https://youtu.be/-q36XnIprfE

Entering New Memories

https://youtu.be/_J6SIXeK-LA

Importing a CSV Configuration

https://youtu.be/OScrih83POA

Uploading New Program to Radio

https://youtu.be/jPwG_AmJoJY

Configuring Banks (Radio Support Req'd)

https://youtu.be/KczGdq5Hx8o

Configuring Menu Settings (Support Req'd)

https://youtu.be/AqFCXk5Xusw

Reordering Memory Slots

https://youtu.be/bbh09VfDt0Q

Importing a CSV with an Offset

https://youtu.be/mchCQicwLr0

Inserting Stock or Info Source Memories

https://youtu.be/9Zm0dxidTJk

References

ARRL Band Plan - http://www.arrl.org/band-plan

CHIRP Software - https://chirp.danplanet.com/projects/chirp/wiki/Home

OARC – http://www.oarc.com

Repeater Book - https://www.repeaterbook.com/

SARA – https://w8wky.org

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