

AllStar
EchoLink
IRLP

The “other” digital voice modes...

ABØL - September 18, 2019

Like DMR, DSTAR or C4FM, voice is converted to a digital stream via a codec.
Conversion happens inside a computer (node) attached to a radio or repeater.
Also called VoIP linking protocols.

IRLP

- Linux based, closed source
- Proprietary hardware you must purchase
- Tightly controlled
- Only radio traffic allowed
- Half-duplex
- Point-to-point linking only



Developer Dave Cameron, VE7LTD. Originally and experiment in linking repeaters in Canada.

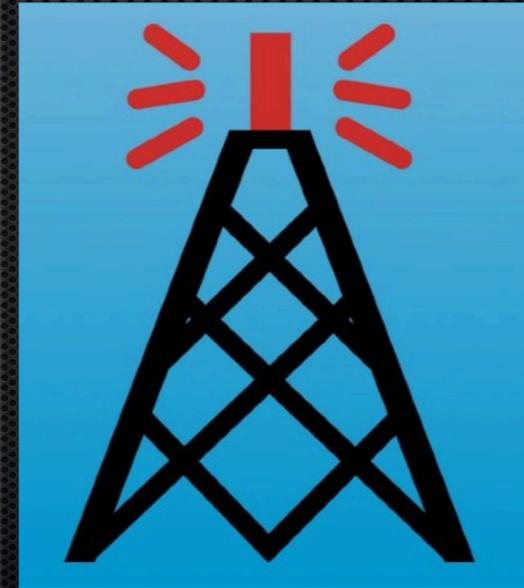
The “Apple” of analog audio linking solutions. Very stable. “Just works.”

\$135 for an IRLP radio adapter board only to \$330 for a turnkey Pi based node.

One-to-one connections, but link can be to special IRLP reflector software. Reflectors must be approved.

EchoLink

- Free, but closed source
- Primarily computer and phone clients
- Relatively poor half-duplex GSM audio
- Largest user base
- Multiple operating modes
- Multi-link via client conferencing and dedicated conference servers



Developer Jonathan Taylor, K1RFD

The “Windows” of analog audio linking solutions. Anything goes.

Official client is Win only but lots of 3rd party ones. Some Kenwood radios have built-in EchoLink support.

Tigertronics SignaLink is popular radio adapter for computer interfacing.

User, Sysop (transceiver) modes. -L callsign suffix for simplex -R suffix for repeater

Low-barrier to entry leads to a LOT of misconfigured nodes (poor audio) and poor etiquette.

AllStar

- Uses Asterisk PBX
- Open source - many implementations
- Excellent full-duplex audio quality with choice of codecs
- Unlimited linking - every node is a hub
- Bridge support to other systems including EchoLink
- Easy firewall setup for clients - no port forwarding!



Jim Dixon, WB6NIL (SK) father of app_rpt an Asterisk module for repeater control.

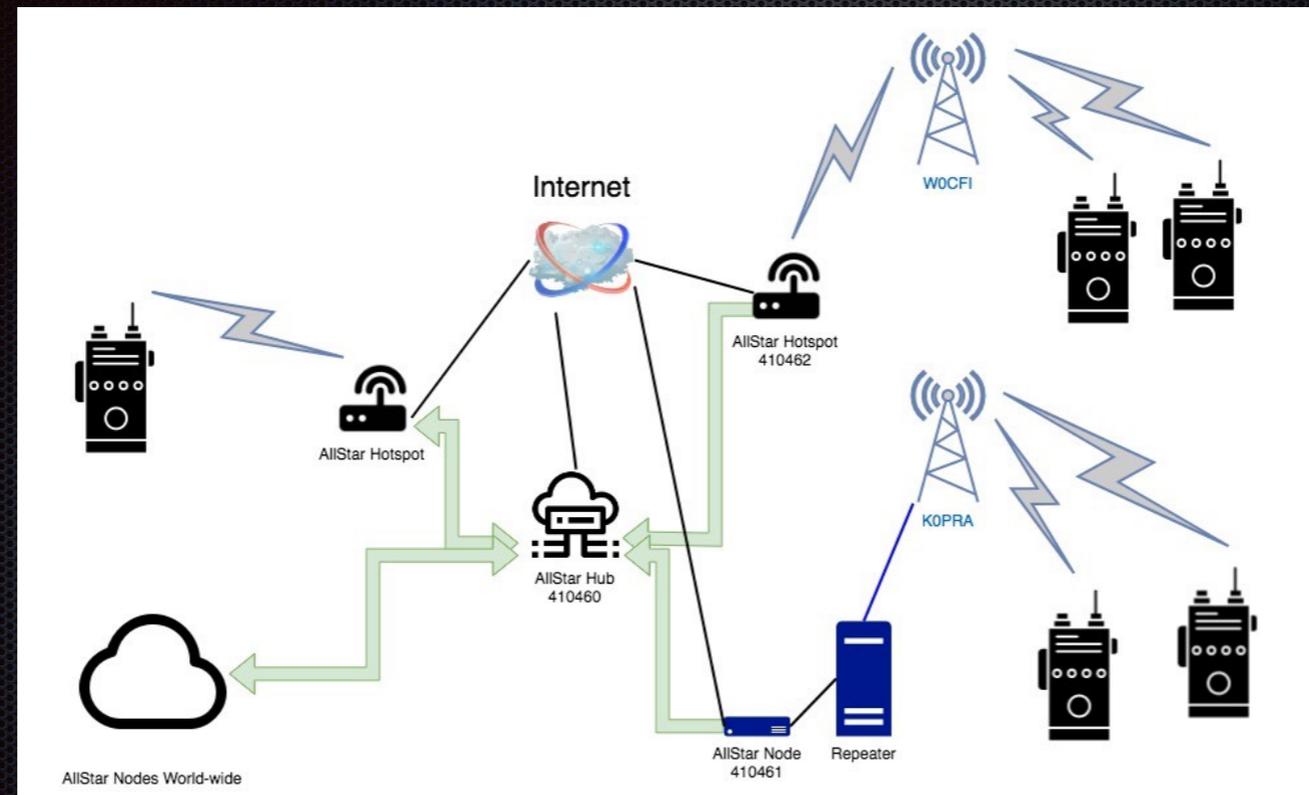
ASL - Originally commercial, now free. Lots of hate for HAMVOIP.

HAMVOIP - Fork of ASL. Made AllStar plug-and-play for Beaglebone and Pi. RasLink - Jeremy Lincicome (Linzicomb), W0JRL, a visually impaired ham who lives downtown Denver. 100% command-line.

Private implementations possible - Colorado Connection repeaters are AllStar linked over microwave connections.

Public implementation uses registration servers to facilitate connections. HAMVOIP uses a customized DNS with fallback compatibility to ASL.

KOPRA AllStar Connections



Hub setup allows water tower links (behind cable modem) to connect.

Also provides a single point of entry to KOPRA world.

Asterisk manages routing and prohibits loops automatically!

WOCFI link "coming soon".

Web control panel for members "coming soon".

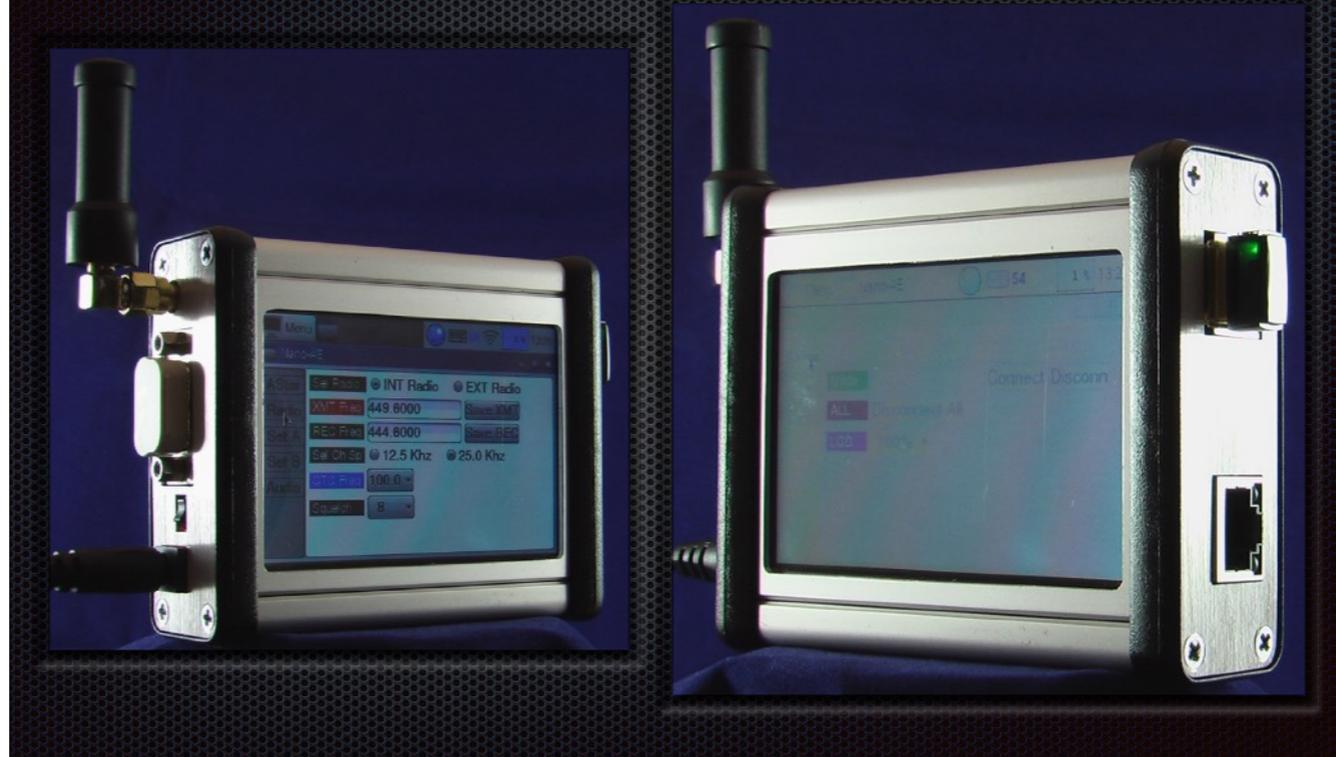
DTMF passthrough from Water Tower maybe...

Frank Roff, KH6BFD in Kona HI uses our setup to talk to a Parker friend.

Demo time!

Commercial AllStar Hotspot

Nano-Node AE Allstar Portable Hotspot



www.micro-node.com

\$495 (WiFi \$30 extra).

Programmable 430-450MHz 0.2 Watt simplex radio.

Commercial AllStar Node

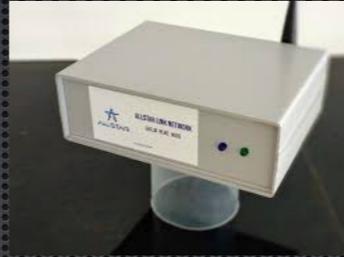
Allstar Radio Thin Client Module (RTCM)



\$269

Plug-and-play - just need URI-style cable to connect to your radio or repeater.

DIY AllStar Node



LOTS of really, really clever builds out there.
Radioless node possible with a mic and speaker.

AllStar Hotspot BOM

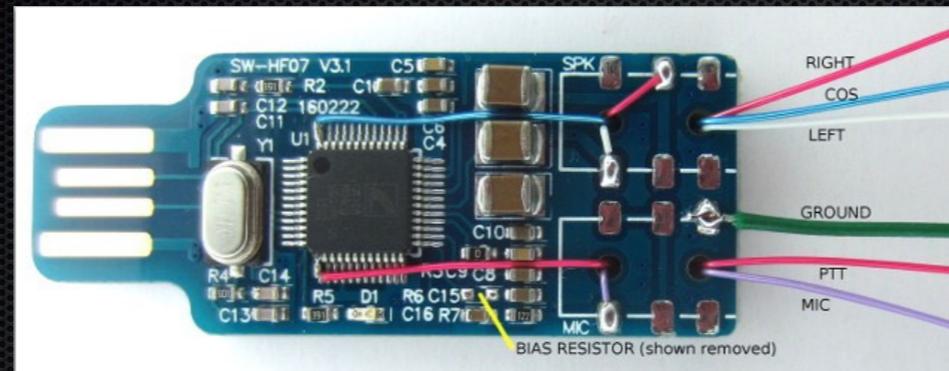
- Raspberry Pi 3/4 - \$30
- 16G microSD card for Pi - \$4
- HAMVIOP image - FREE!
- Masters Communications RA-42 \$42 or modded CM108 USB fob \$3
- Baofeng 888 UHF radio - \$14
- 5V 2.5A power supply - \$10
- Case, Antenna(s), LEDs, wire, small parts - \$Varies

Complete ASL hotspot can be built for <\$50 if you're really thrifty and have healthy parts bins. Under \$100 is more typical for a build.

DMK URI and Repeater Builder USB RIM are also radio interface options at ~ \$100.

ANY radio with TX/RX audio, PTT and COS (Carrier Operated Switch) signals will work! Many mobile rigs put these signals right on the accessory port (Alinco DR135, 235, 435).

CM108 USB fob mod



- Desolder mic bias voltage resistor
- PTT direct to pin 13. Transistor needed to invert signal.
- COS direct to pin 48. Diode needed to keep higher fob voltage from leaking back to radio.

Wire-wrap wire works best.

Use hot glue for strain relief.

Need quality iron with fine tip to work QFP pins. Use flux!

DON'T remove jacks unless you've got Chip Quik. You'll wreck the pads, guaranteed.

TX/RX audio levels will need to be managed with resistors if outside of HAMVOIP tuning range.

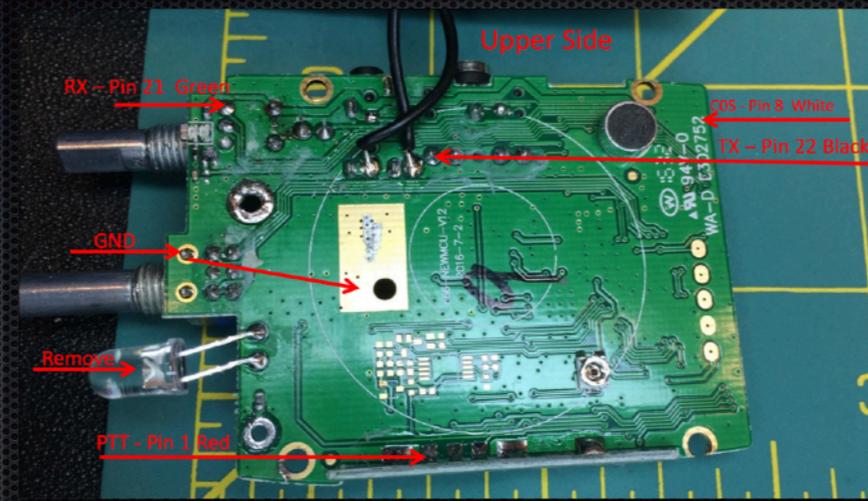
Masters Communications RA-42



- Fun kit. QFPs are pre-soldered. Everything else is through-hole.
- Highly configurable with tunable amps for TX and RX audio levels.
- All PTT inversion and signal protection built-in.

Hold off on soldering USB and DB9 jacks until you decide on how you want to interface the Pi and radio in your setup. Consider setting .1 header pins for LEDs and mounting them to the case instead with jumper wires.

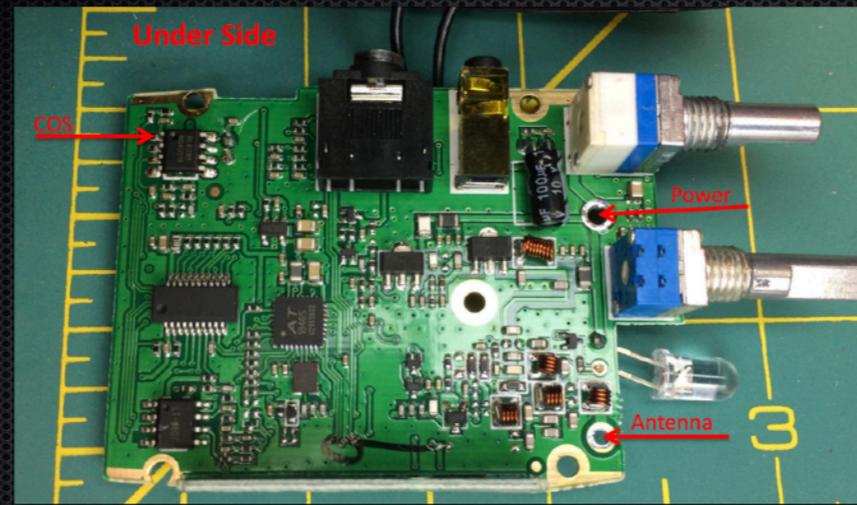
Baofeng 888 disassembly



- Don't forget castle nuts on volume and channel shafts.
- Antenna jack must be de-soldered.
- Disconnect speaker and LED too.

There are multiple revisions of the 888 board!

Baofeng 888 disassembly cont.

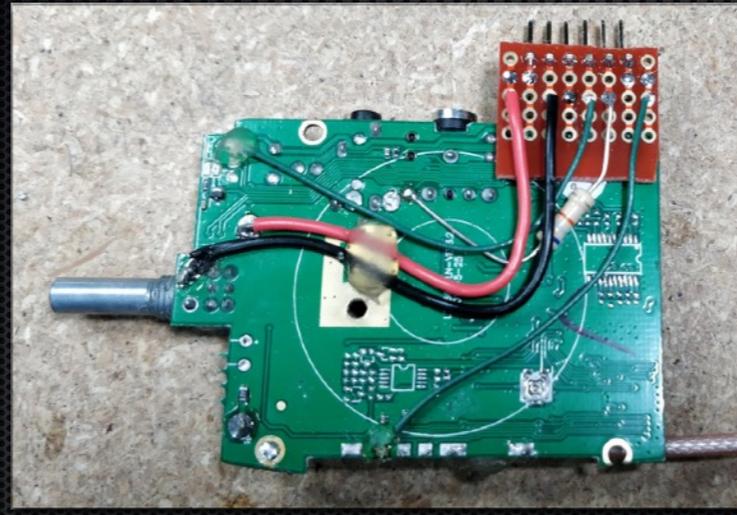


- Volume / power switch can be removed if you like.
- Probably best to leave channel selector, though it can be hard-wired if you prefer.
- Leave headphone / mic jacks alone! You need them to program the radio.

Vertical button pad can be desoldered.

Use hot glue liberally as strain relief for all attachments.

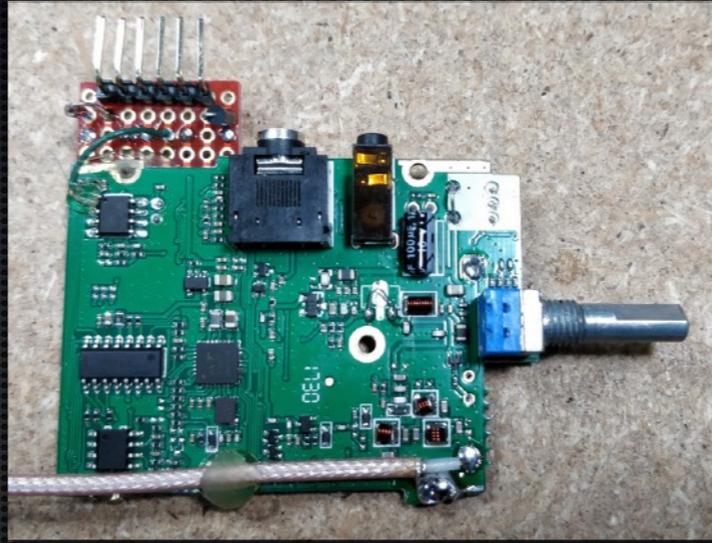
My 888 mods



- Signals all routed to perfboard/headers for durability.
- Resistor to mic input from legacy build. Lazy so I left it alone.

I LOVE HOT GLUE!

My 888 mods cont.



- Final transistor removed and bypassed for 10mW operation.
- Note power diode on V+ to bring voltage down a bit.

Volume/Power switch removed and jumper applied.

Signal diode on PTT because voltage was bleeding through causing PTT light to glow dimly.

Putting it all together



DC-DC buck converter with LC filter (from LM2596 datasheet).

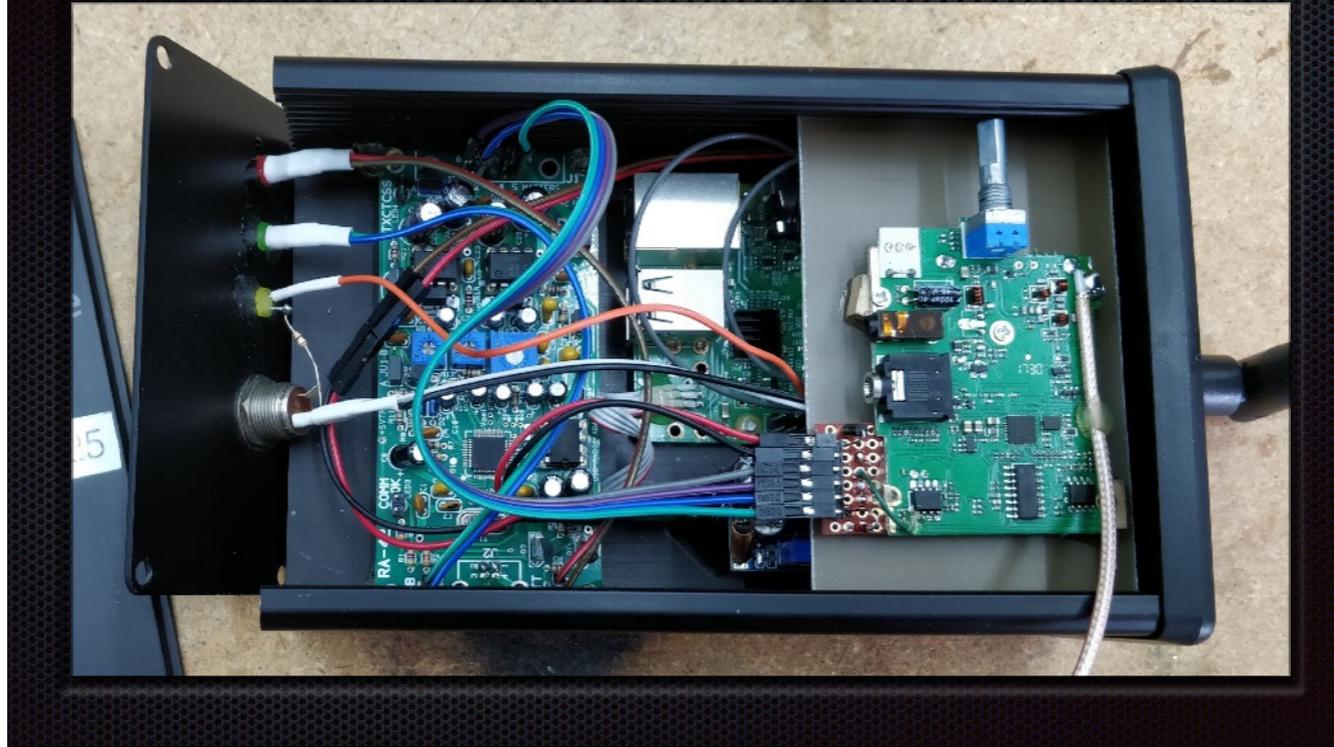
Pi Mods: Removed ceramic WiFi antenna and wired to external. Removed one USB block and direct-wired RA-42.

Header pins for radio interface.

Pi system LED redirected to GPIO pin via boot config parameter.

GPIO pins also used for halt button signal (HAMVOIP feature).

Putting it all together cont.



PTT and RA-42 heartbeat LEDs brought out to panel.

Pi system LED brought out to panel (shows HAMVOIP heartbeat during normal ops.)

UHF antenna mounted to top panel.

Operating Tips

- Love DTMF, hate DTMF.
- Beeps and boops, or how to deal with courtesy tones and telemetry.
- Reverse SSH tunnel FTW!
- Bookmark <http://stats.allstarlink.org/>
- Be a good ham. Announce your DTMF.



Some radios are better at DTMF than others. Too loud, too soft, missing ABCD, etc.

Baofeng DTMF config gotcha.

Look at the DTMF macros setup in the configs to make your life easier.

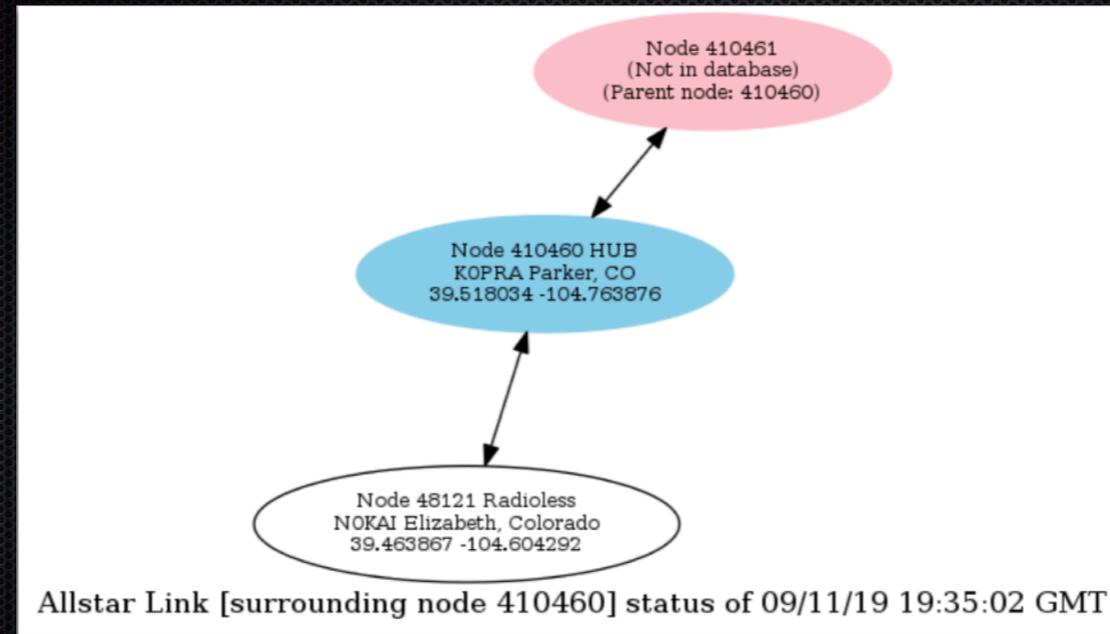
Want to totally shut up a node? duplex=0 in rpt.conf. Legal???

Use a systemd service to keep a persistent reverse SSH tunnel back to a publicly accessible host of your own.

Having easy access to the HAMVOIP UI means you can always enter commands direct to Asterisk w/o fighting DTMF.

While connected, always announce with your call that you're about to send DTMF ASL commands. Even though there's options to suppress, a bit does leak past and you'll still have the linked repeaters keyed up while sending.

AllStar Stats bubble map



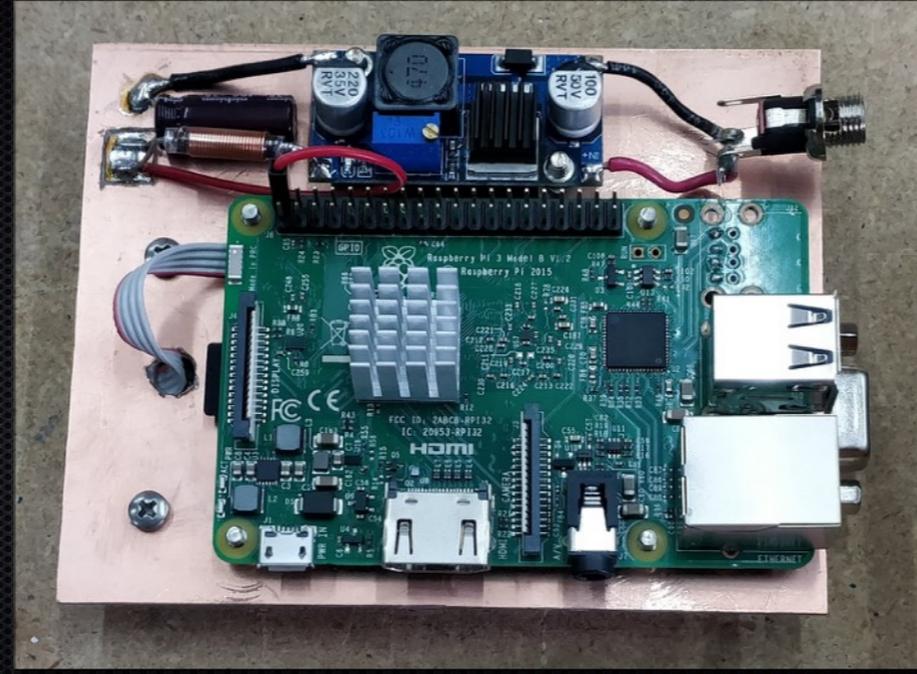
ABØL shack setup



- 2 AllStar nodes, one server, in one box.
- 47712 connected to Kenwood TM-V71A via RA-42, 48121 radioless via CM108 fob with EchoLink configured.
- Custom CAT control of Kenwood via DTMF commands from any node (even remote).

Display rotates through various data including link status for both nodes, active memory channel on the TM-V71A, and accurate time display (shack clock #1)
Buttons don't do much except shutdown Pi.

Water Tower AllStar node



Very similar to the hotspot, just no integrated radio.

Water Tower AllStar node



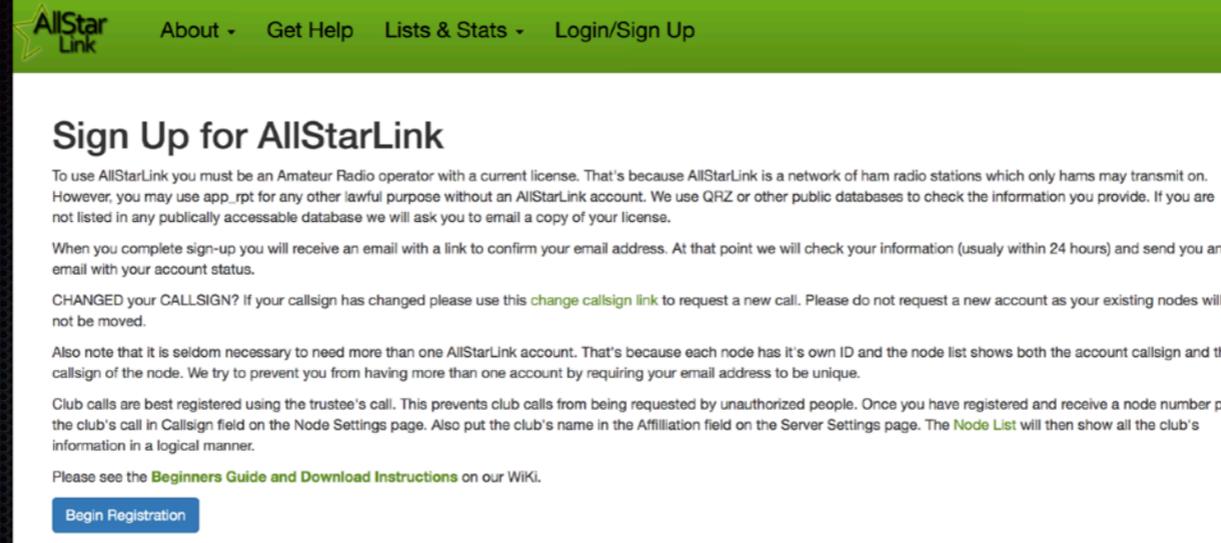
Water Tower AllStar node



Water Tower ASL node



ASL registration

The image shows a screenshot of the AllStarLink website's registration page. At the top, there is a green navigation bar with the AllStarLink logo on the left and menu items: 'About -', 'Get Help', 'Lists & Stats -', and 'Login/Sign Up'. Below the navigation bar, the main content area has a white background. The heading 'Sign Up for AllStarLink' is prominently displayed. The text explains that users must be Amateur Radio operators with current licenses and provides instructions on how to use the system, including details about email verification, handling call sign changes, and club registration. A blue 'Begin Registration' button is located at the bottom of the text area.

AllStarLink About - Get Help Lists & Stats - Login/Sign Up

Sign Up for AllStarLink

To use AllStarLink you must be an Amateur Radio operator with a current license. That's because AllStarLink is a network of ham radio stations which only hams may transmit on. However, you may use app .rpt for any other lawful purpose without an AllStarLink account. We use QRZ or other public databases to check the information you provide. If you are not listed in any publically accessible database we will ask you to email a copy of your license.

When you complete sign-up you will receive an email with a link to confirm your email address. At that point we will check your information (usually within 24 hours) and send you an email with your account status.

CHANGED your CALLSIGN? If your callsign has changed please use this [change callsign link](#) to request a new call. Please do not request a new account as your existing nodes will not be moved.

Also note that it is seldom necessary to need more than one AllStarLink account. That's because each node has it's own ID and the node list shows both the account callsign and the callsign of the node. We try to prevent you from having more than one account by requiring your email address to be unique.

Club calls are best registered using the trustee's call. This prevents club calls from being requested by unauthorized people. Once you have registered and receive a node number put the club's call in Callsign field on the Node Settings page. Also put the club's name in the Affiliation field on the Server Settings page. The [Node List](#) will then show all the club's information in a logical manner.

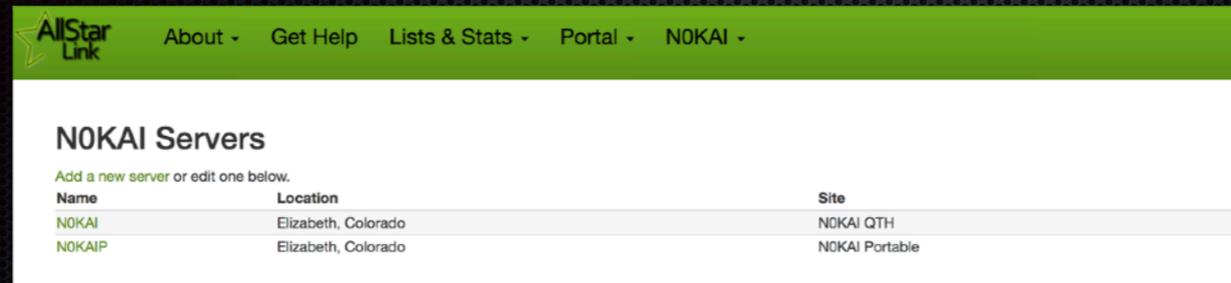
Please see the [Beginners Guide and Download Instructions](#) on our Wiki.

[Begin Registration](#)

Regardless of distro, start here.

Processed in under 24 hours. <1 isn't unusual during the day.

ASL server setup



Name	Location	Site
NOKAI	Elizabeth, Colorado	NOKAI QTH
NOKAIP	Elizabeth, Colorado	NOKAI Portable

- Typically one node per server but servers can support multiple nodes.
- Think of the server as the Pi, nodes as radio adapters.
- Remember to change the IAX port number if you're running multiple servers on the same IP.

ASL node setup

AllStar Link About - Get Help Lists & Stats - Portal - NOKAI -

NOKAI Nodes

Press Continue to:

- Request a new node number from AllStarLink.
- Extend a node number up to 10 nodes.
- Delete a node number.

[Continue...](#)

Or click a node number below to edit it.

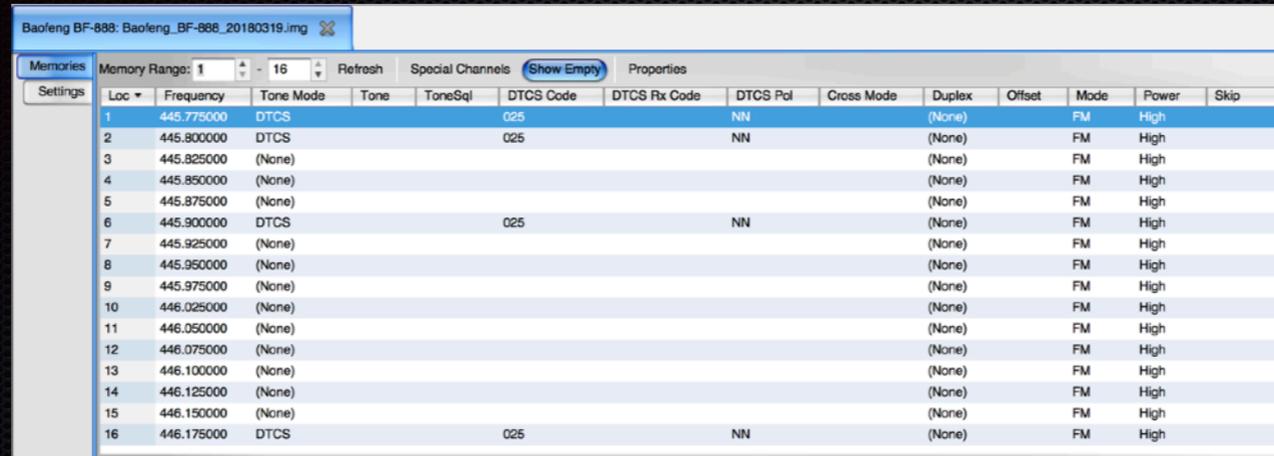
Node Number	Server	Callsign	Password ¹	Web Xceiver	Show Cmds	Rvrs Ap	Phone Portal	Rmt Base	Agile	NNX
47712	NOKAI	NOKAI		Yes	Yes	No	Yes	No	No	No
47818	NOKAI/P	NOKAI		No	Yes	No	No	No	No	No
48121	NOKAI	NOKAI		Yes	Yes	No	Yes	No	No	No

¹ Mouseover password to show.

- Most config options aren't recognized by HAMVOIP, but no harm in filling it out.
- Node numbers are human-issued and take time. Typically an hour or two during business hours.
- New "extend" feature allows self-service of generating up to 10 node numbers off an existing one.

Hover over the password field to reveal the node password. You'll need it for setup.

Radio config (CHIRP)



Loc	Frequency	Tone Mode	Tone	ToneSql	DTCS Code	DTCS Rx Code	DTCS Pol	Cross Mode	Duplex	Offset	Mode	Power	Skip
1	445.775000	DTCS			025		NN		(None)		FM	High	
2	445.800000	DTCS			025		NN		(None)		FM	High	
3	445.825000	(None)							(None)		FM	High	
4	445.850000	(None)							(None)		FM	High	
5	445.875000	(None)							(None)		FM	High	
6	445.900000	DTCS			025		NN		(None)		FM	High	
7	445.925000	(None)							(None)		FM	High	
8	445.950000	(None)							(None)		FM	High	
9	445.975000	(None)							(None)		FM	High	
10	446.025000	(None)							(None)		FM	High	
11	446.050000	(None)							(None)		FM	High	
12	446.075000	(None)							(None)		FM	High	
13	446.100000	(None)							(None)		FM	High	
14	446.125000	(None)							(None)		FM	High	
15	446.150000	(None)							(None)		FM	High	
16	446.175000	DTCS			025		NN		(None)		FM	High	

- ALWAYS use PL tone or DTCS. Otherwise, unwanted traffic could be passed back into your connected ASL nodes.
- Set power to low unless you removed the final transistor, then it doesn't matter. Might want to adjust the timeout timer in settings as well.

Consider setting up several frequencies based on the band plans of the places you frequently travel.

HAMVOIP 1st boot

- Is your hotspot wireless? Google for the tip in placing a pre-built WiFi config file on the Pi SD card prior to boot.
- Have your HT on the right frequency and you'll hear the server beep out it's IP address in morse code during startup.
- Code copy rusty? Find the IP in your firewall or router's DHCP logs. Look for 'ALARM' (I think).
- Using your favorite terminal client (Putty, etc), connect to the server IP via ssh on port 222. Login is root, password is root.
- The "First Time" script will start automatically. Fill in all the goodies, including your node password. Refer to <https://hamvoip.org> directions if you get stuck.
- Firewall / port-forwarding is not required for outbound AllStar connections. To allow inbound, you'll need to port-forward UDP for your IAX port (typically 4569) to your server.

An active Internet connection is required to complete setup.

You can skip over the simpleusb-tune part for now. You'll be spending a fair bit of time in there later fine-tuning audio levels.

There are more port forwarding requirements for EchoLink, if enabled.

Welcome to HAMVOIP!

```
Admin Menu List for: n0kai (192.168.0.11)
Please select:
1 Perform a system UPDATE (Internet access required)
2 Change the ROOT password
3 Change the primary NODE number
4 Change the system Timezone
5 Change the system Hostname
6 Configure the Wired Ethernet Networking
7 Configure the WiFi Interface Networking
8 Change the Secure Shell (SSH) port
9 Start Bash shell interface
10 Display System Version Numbers
11 Run Asterisk CLI client
12 Run simpleusb-tune-menu Application
13 Restart Asterisk Server
14 Power-cycle the USB sub-system
15 Reboot this system
16 Perform system power down

<Run Selected Item>      < Exit / Logout >
```

Tip: To force a re-run of the “First Time” setup, select 3, Change primary node #.

Summon a bash shell via 9. Sadly, you will be editing config files from the command line at some point.

Asterisk CLI

```
Starting Asterisk client. Please type: exit<ENTER>
when done and you will return to the admin menu.
```

```
Asterisk 1.4.23-pre.hamvoip-V1.5.3-58-app_rpt-0.327-07/22/2019, Copyright (C) 1999 - 2019
HamVoIP.org and others.
Created by Mark Spencer <markster@digium.com>
Asterisk comes with ABSOLUTELY NO WARRANTY; type 'core show warranty' for details.
This is free software, with components licensed under the GNU General Public
License version 2 and other licenses; you are welcome to redistribute it under
certain conditions. Type 'core show license' for details.
=====
Connected to Asterisk 1.4.23-pre.hamvoip-V1.5.3-58-app_rpt-0.327-07/22/2019 currently runn
ing on n0kai (pid = 335)
Verbosity is at least 4
n0kai*CLI> rpt fun 47712 *1410460
```

Monitor Asterisk events (including DTMF decodes).

Enter commands to HAMVOIP via 'rpt fun'.

Asterisk can also be called from the command line - perfect for scripting.

simpleusb-tune

```
Active simpleusb device stanza: [usb] -----
S) Select active USB device stanza
V) View COS, CTCSS and PTT Telemetry using real-time display
P) Print Current Parameter Values ---- 2) Set Rx Voice Level (using display)
3) Set Transmit A Level ---- 4) Set Transmit B Level
5) Set Tx Audio Level Method (currently LOG)
7) Set Transmit DSP Level
B) Toggle RX Boost Mode (currently Disabled)
C) Toggle Echo Mode (currently Disabled)
D) Flash (Toggle PTT and Tone output several times)
E) Toggle Transmit Test Tone/Keying (currently Disabled)
K) Manually key COS (currently Unkeyed)
F) Toggle PRE-emphasis Mode (currently Enabled)
G) Toggle DE-emphasis Mode (currently Disabled)
H) Toggle PLfilter Mode (currently Enabled)
Q) Toggle DCSfilter Mode (currently Disabled)
I) Toggle PTT Mode (currently active LOW)
J) Change COSFROM Mode (currently "usb")
L) Change CTCSSFROM Mode (currently "no")
M) Change RXONDELAY value (currently "25")
N) Change RXAUDIODELAY value (currently "0")
W) Write (Save) Current Parameter Values
0) Exit Menu

Please enter your selection now: █
```

V to view live telemetry.

2 & 3 (main) to set audio levels (4 is aux/tone audio).

C enables "parrot" (local only). There are real AllStar parrot nodes - google.

If PTT keeps "looping" due to squelch tail, tweak RXONDELAY.

Don't forget to W!

Common HAMVOIP config files

- `/etc/asterisk/rpt.conf`
“main” config file. Pretty well commented.
- `/etc/asterisk/iax.conf`
Codec and network settings.
- `/etc/asterisk/simpleusb_tune_*.conf`
Pretty well handled by simpleusb-tune.
- `/etc/asterisk/echolink.conf`
EchoLink setup.
- `/usr/local/etc/allstar.env`
Lots of startup options.
- `root crontab`
Stop the silly hourly time announcement.

There are more... Lots more.
Use a light touch.

Getting help

- Google site search of hamvoip.org for specific questions.
- Very active listserv at <http://lists.hamvoip.org/cgi-bin/mailman/listinfo/arm-allstar> - best way to reach developers.
- <https://web-tpa.allstarlink.org/support/> - beware though - HAMVOIP is a fork of ASL.

hamvoip.org homepage is deceptively simple. There's a LOT of nested and buried content. Good site search is your friend here.

ASL has wikis and support forums but beware - there's bad blood between these teams. Also, not all ASL configs and commands are identical to HAMVOIP!

AllStar's ugly cousin (Network Radio)

- Zello
- IRN (International Radio Network)
- Teamspeak
- Skype
- <https://network-radios.com>



Loosely (or not at all) coupled with ham radio.

IRN supports ham repeater linking. You have to prove you're a licensed ham to get extended IRN privileges.

Very popular in Europe. Some IRN channels will put any repeater or DMR talk group to shame.

Lots of cool hardware - basically android phones with PTT features and sometimes even other radios built-in. Dual-band Network Radio HTs with DMR support just now coming available.

Rob Greenberg, W2CYK Rfinder guy, is working on the radio to rule them all - android network radio with SDR transceiver that will support ALL modes.

All are android apps that can be installed on your phone today if you want to play around.

Obligatory cat pic

"Do they still worship us, child?"
"Well, I shit in a box and they clean it."
"Good. Good."



Thanks for listening!
73, ABØL