CROSS ROADS HAM RADIO CLUB

Tech Net

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CRHRC Repeater Network

Presented by Tech Net Committee

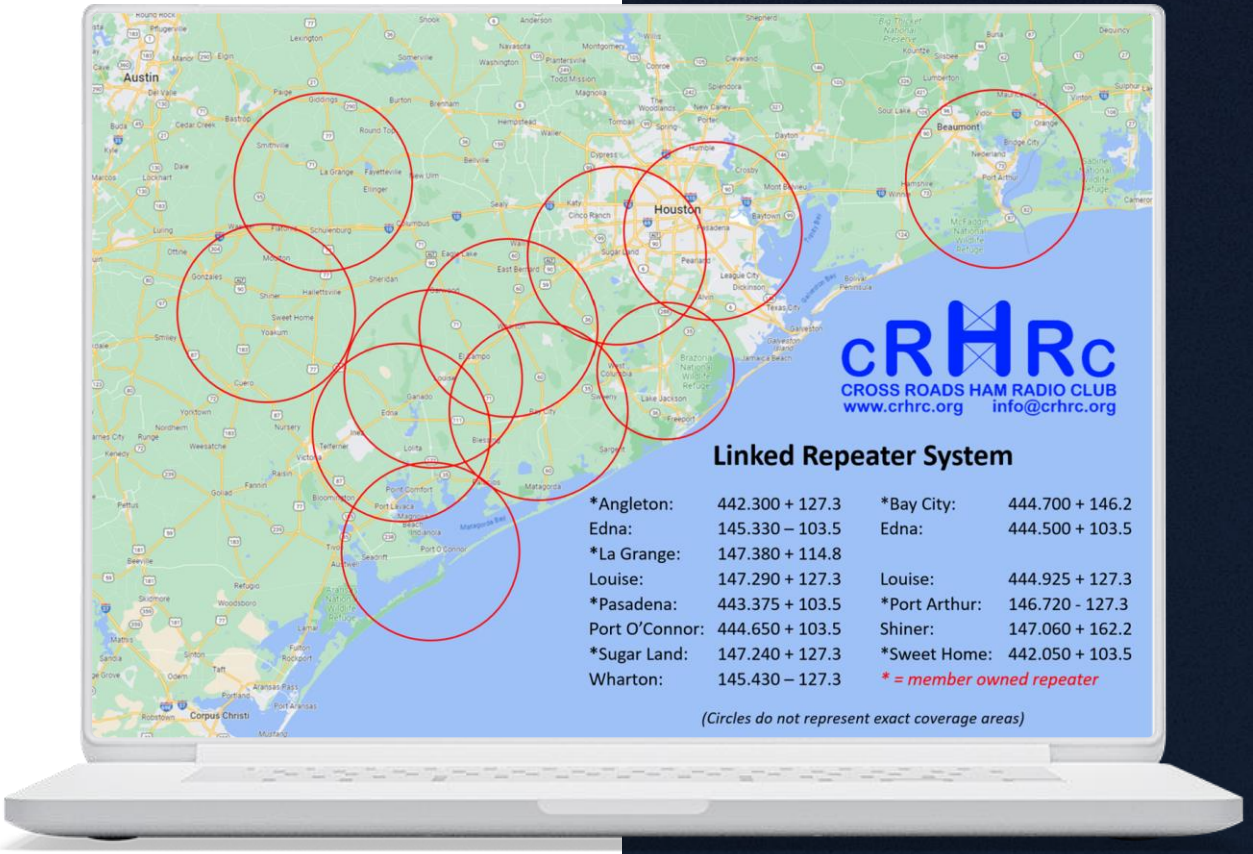
11.01.2023

Introduction

Hello everyone, my name is Robert, and my call is KB5PBM.

During our member survey, we received quite a bit of interest in learning more about amateur radio repeaters. We decided this would be a great topic to launch the first CRHRC Tech Net.

I want to start tonight's tech net with an explanation of a typical repeater site. We have been fortunate to place our repeaters at several towers throughout the CRHRC area.



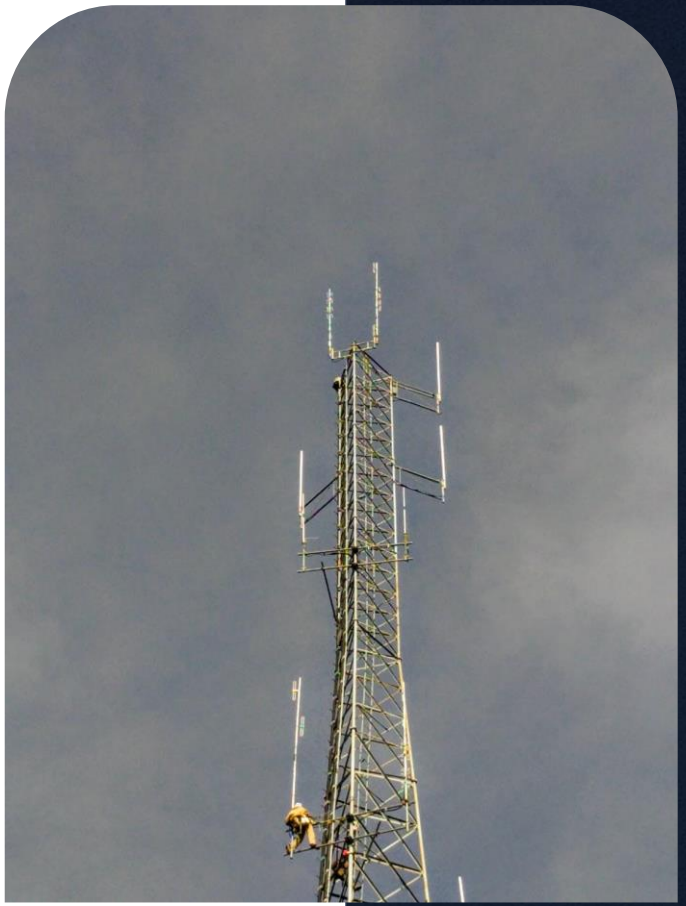
Antenna

On each tower we have our antenna.

We choose a commercial quality single band antenna for each repeater (or a j-pole – just kidding). The antenna of choice has been the CommScope? DB420 for UHF and Db224E for VHF.

These antennas are very durable and have considerable gain with 11db for the DB420 and 8db for the Db224E. They are omnidirectional antennas for the most part, but due to the proximity of the tower will make them somewhat directional.

Both antennas are DC grounded. This means the loop at one end is fed with the signal and the other end of the loop is grounded. This configuration is ideal for tower use due to low noise and lightning protection.



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DB224

RF connector inner conductor and body grounded to reflector and mounting bracket.

Frequency Band, MHz: 138–150
Gain, dBi: 8.1
Beamwidth, Horizontal, degrees: 360
Wind Speed, maximum: 130 km/h (81 mph)

dB420

RF connector inner conductor and body grounded to reflector and mounting bracket

Frequency Band, MHz: 450–470
Gain, dBi: 11.3
Beamwidth, Horizontal, degrees: 360
Wind Speed, maximum: 161 km/h (100 mph)

DB224 Link
dB420 Link

Feedline

From the antenna near the top of the tower we are then connected to our feedline.

This is usually 7/8 helix. which is a 50 ohm low loss feedline. This has a loss of about .8 db per 100 ft @ 450 mhz. Some sites Like Edna will have 400+ ft of feedline. In this case, using a high-quality low loss feed line limits the signal between the radio and the antenna to only 3.2db.

So, a good feedline is very important to make sure our system has good receive and transmit range.

(Chart on next slide.) →

Jacket Material: PE
Outer Conductor Material: Corrugated copper
Dielectric Material: Foam PE
Flexibility: Standard
Inner Conductor Material: Copper tube
Jacket Color: Black
Dimensions
Nominal Size: 7/8 in

Attenuation Frequency (MHz)	Attenuation (dB/100 m)	Attenuation (dB/100 ft)	Average Power (kW)
150	1.475	0.449	6.16
450	2.65	0.808	3.43
840	3.694	1.126	2.46

https://www.rfparts.com/coax/heliaxcoax/heliax-78inch/ldf5-50a.html

Grounding

Now we get down to where the repeater is housed.

The hardline from the outside must be grounded to protect all equipment from any electrical failures or lightning strikes up on the tower. Lightning can not only damage our equipment but can damage other equipment we are sharing the location with.

Proper grounding is critical!

Ground entire system for safety.

Duplexer

So, after we get all the tower failures and lightning out of the hardline, we come to our duplexer.

The Duplexer allows our repeater to transmit and receive simultaneously on and 2 different frequencies an input frequency and an output frequency, creating a full duplex signal. You as the operator can only operate in a simplex mode. You can either transmit or you can receive. This is why your radio is programmed with an “off-set” transmit frequency when communicating over a repeater. But using these duplexers the repeater can do both at the same time.

The function of the duplex-er is to separate the transmit and receive into two different paths. It does this but using a tuned cavity which on the transmit path, notches or filters out the receive frequency and on the receive path notches out the transmit frequency. So on a duplex-er you have a connector for the antenna and two separate connectors for the transmit out and the receive in on the repeater.

(Images on next slide.) →

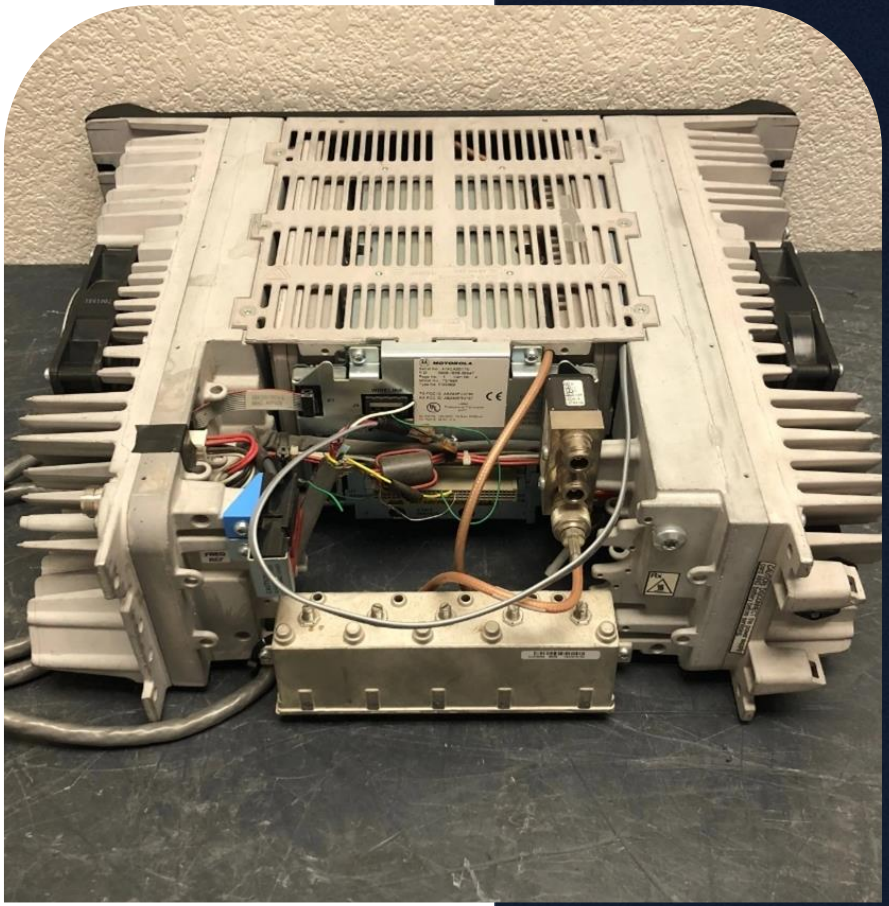
Splits the transmit and Recieve Signals into two paths
Transmit path notches the recieve frequency
Recieve Path notches the transmit frequency

The Repeater

Now that we have the transmit and receive separated and the lightning grounded, we can plug our two connectors in the repeater itself.

CRHRC uses the Motorola MTR2000. These are known for being very durable and dependable repeaters. On this repeater there are two ports, one for the transmitter and one for the receiver. The repeater is the radio which receives and transmits the signal on the two different frequencies. You have an input and output frequency.

The repeater also decodes the PL tone from your radio and decides whether its valid or not. If not, the audio is not forwarded to the Interface board and not transmitted out of the repeater. But if the repeater receives a good PL tone the Audio is passed to the Repeater Interface Board and out to the transmitter.



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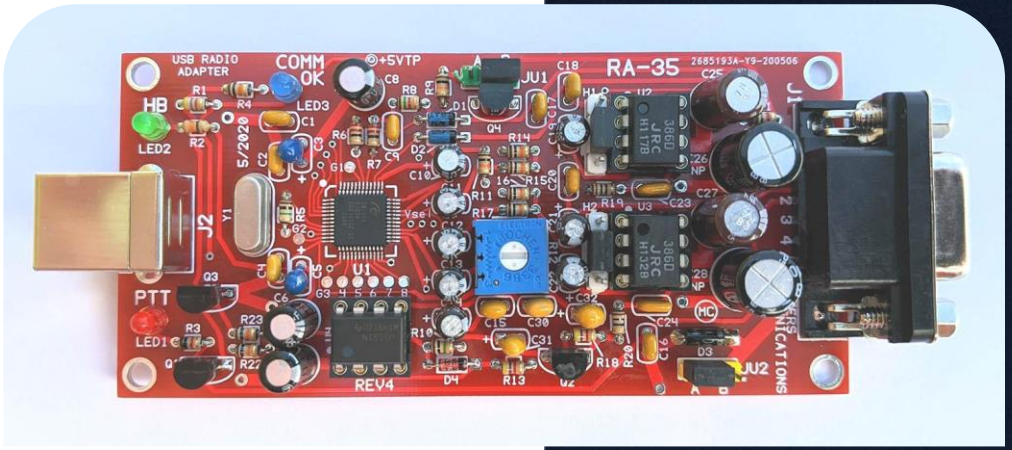
MTR2000b

Radio Interface

Radio Interface

The Allstar Radio interface is made of a micro or minicomputer which contains a sound chip to route audio to and from the Allstar network and the repeater. As well as control the Push to talk (key repeater) and control the COR (sense the detection of a signal).

The COR detection is important. This tells Allstar that a signal is being received from the operator and to key the other repeaters on the network. Without this lead signal the far end connected repeaters or and the local repeater would not transmit.



RA-35 Radio Interface

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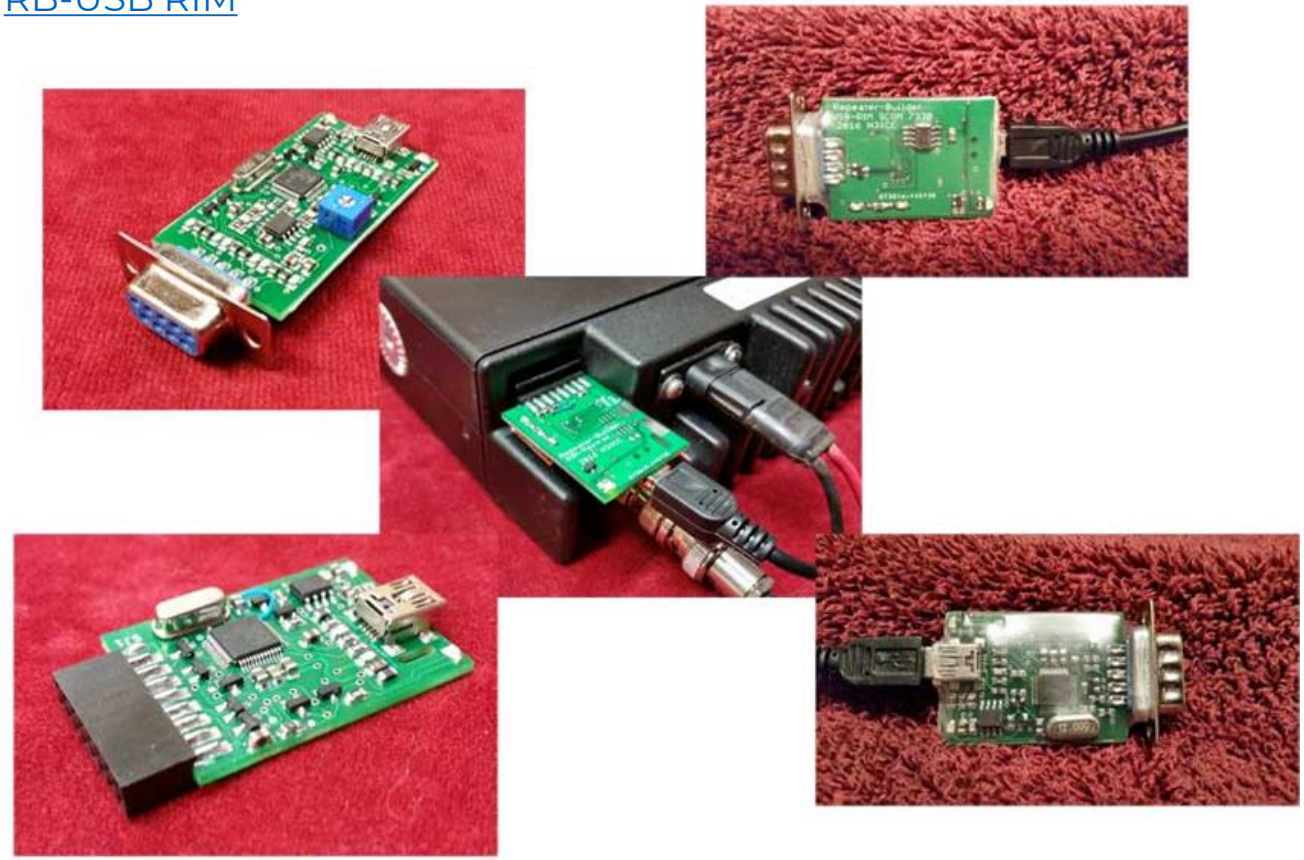
RB-USB RIM



URI Interface

RA-35 D89 Pinout:

1 - Right (Aux or Tone) Output

2 - Left (Main or Voice) Output

3 - COS Logic Input - (pull near ground required for valid input)

4 - CTCSS Logic Input - (pull near ground required for valid input)

5 - PTT Output

6 - Discriminator / Detector or Receiver Audio Input - (level controlled by potentiometer)

7 - Local Control (Control Revert) Logic Output (Use with JU1 - see note below)

8 - Ground - (Digital and Analog)

9 - External Audio Amplifier Power (6 to 15 VDC) (Use with JU2 - position B)

Allstar

Allstar is the heart of the CRHRC Linked system. Allstar was created by a silent key ham Jim Dixon, WB6NIL. His knowledge of PBX phone systems lead him to integrate the asterisk PBX opensource software to link our repeaters using several modules written for the asterisk PBX. These are the rpt module which is the core or the repeater controller along with several channel modules to connect repeaters, echolink and other software to the allstar network.

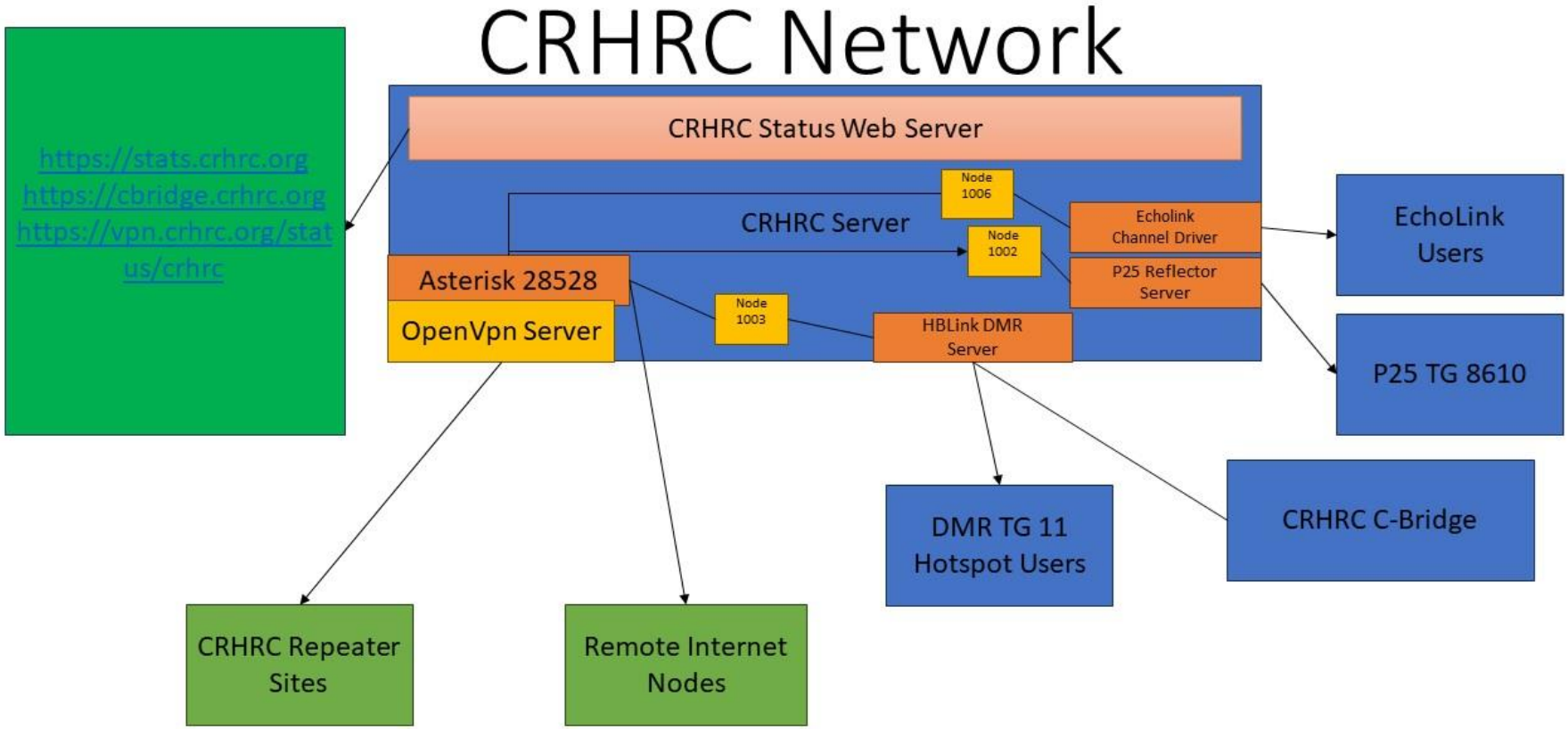
Two of the channel modules we use to connect to the repeaters are usbradio and simpleusb. These modules communicate with the chips of the repeater interface board. Other major code contributors include Steve Rogers, WA6ZFT, Steven Henke, W9SH, Mike Zingman, N4IRR, Steve Zingman, N4IRS along with many others.

Each AllStar controlled repeater is called an AllStar Node and assigned a unique AllStar Node number from AllStarLink.org.

AllStar is also used to create a Hub. This Hub functions very similar to a “conference” where individual repeaters or “Nodes” can be connected and disconnected to create a network of linked repeaters as we have done for the Cross Roads Linked Repeater System.

The Allstar network does this by keeping several key information variables to allow connectivity between nodes. These include the IP address, Node number and UDP port. All these variables are needed to make a connection between nodes. This information is collected when nodes send a register request to the Allstarlink.org server. Each node is constantly downloading this information every 300 seconds to keep up the changes in IP addresses.

CRHRC Network



Between nodes Allstar uses IAX (Inter-Asterisk eXchange) to communicate. This protocol operates on UDP port 4569. This makes a very efficient communication link between nodes. There are only keep alive or a series of “are you there”, “yes im there” packets. The only high traffic times is when the repeaters actually have traffic.

Another great benefit is the selection of codec’s that can be used between repeaters. This is good for sites that have cell modem coverage or low bandwidth DSL internet and very limited on bandwidth. You can use a different codec with lower bandwidth to compensate. An example would be the uLaw codec. This codec when transmitting uses about 80 to 100kb/s. On a cell modem or very low bandwidth DSL line this could cause the voice to drop out which is very annoying, The Node admin can change this from Ulaw to ITU G.726 which only uses approximately 32kbps. You will lose some voice quality but your network will be more stable. Another reason to use the lower codec, you may only have 10 gb of data on that cell modem. Lowering to 32kb/s might help in keeping you under that cap.

There are many other features using a PBX as a repeater controller can bring to the table. You can make dial able extension to connect to your repeater. There are several networks such has hamshack hotline that are doing this very thing. They have extensions that connect to he RPT controller and users are able to talk on repeaters using a SIP IP phone. Cool recordings can be created to customize your node.

Allstar is not only the current versions of Allstar out there. Another very popular is Hamvoip. Hamvoip was started fellow ham WA3DSP Doug Crompton. He set out to create an image for the Beagle Bone (Similar to a Raspberry Pi) to work with the URI from DMK engineering. Hamvoip has come a long way with creating a very easy step by step process to get you up and going very easily. They have also made several addition to allstar as well as scripts to easily manage the image they provided.

In short Allstar provides the ability to connect to external applications such as EchoLink, DV Switch, DMR, P25, and CBridge controllers giving us the ability to bring many different modes of communications, both analog and digital into the network.

Currently CRHRC has Node 28528 connected to talkgroup 11 on our HBlink server as well as our Cbridge repeaters. You can check the status of these on our site under the Repeaters menu link

Reference Links

Jim Dixon History: https://wiki.allstarlink.org/wiki/ASLCorporate:History
Allstar Link: https://www.allstarlink.org/
Hamvoip: https://www.hamvoip.org/
History of Jim Dixon on Asterisk PBX:
https://www.youtube.com/watch?v=KC5I9rRoc0Q&t=1235s&pp=ygUQamltIGRpeG9uIHdiNm5pbA%3D%3D
Jim Dixon Astericon Talking Allstar:
https://www.youtube.com/watch?v=dGn5Ug0uvLs&pp=ygUQamltIGRpeG9uIHdiNm5pbA%3D%3D

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