

900 MHz FM – CENTRAL TEXAS



WHY 900 MHz ?

- 900 MHz is a new frontier for FM operation
- It is very much like 70 cm was 45 years ago
 - *Radios are modified commercial gear: mostly Motorola or Kenwood*
 - *Propagation is more challenging than lower frequency bands (2M – 70CM)*
 - *Technical interest*
 - *Weak signal compatible*

WHAT IS 900 MHz OPERATION LIKE ?

- Similar to 70 CM with
 - *Faster mobile flutter*
 - *More multipath*
 - *Greater building penetration due to reflections*
 - *A bit more path loss*
- A good antenna is extremely important
- 12W to 15W is adequate
- 30W radios are available
- Feed line losses are greater (use low loss coax)
- *900 MHz culture is not typical FM*

SOME HISTORY


- *August 2007 I visited friends in W. Texas*
- *We talked about 900 MHz and plans for ROIP linking*
- *I returned to Portland 'stoked' to get on 900 MHz*

- *My 1st 900 MHz repeater was operational in 2007 (Portland)*

- *The 2nd machine on the air -March 2008 (Larch Mountain SW Washington)*



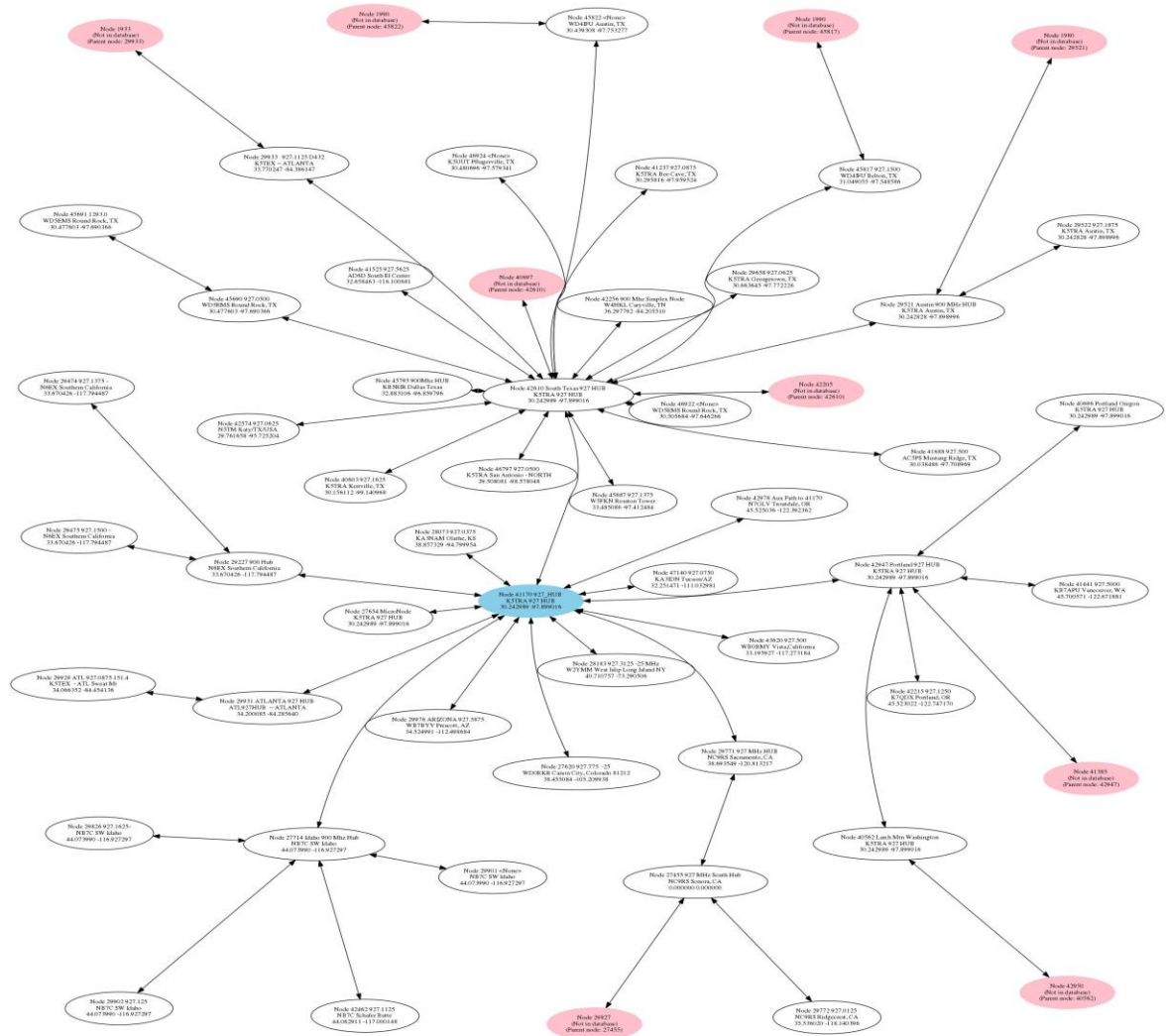
MORE HISTORY

- *Early internet linking of 900 MHz began in 2008*
- *1st Austin 900 MHz repeater operational in 2009*
- *K5TRA moved back to TX in 2010*
 - *Several additional RF linked Austin area 900 repeaters added*
 - *Linked to other areas/states via ROIP*
- *Austin based 927 TECH linking HUB began in 2011* 
 - *Many 900 MHz repeaters joined the network*
 - *EchoLink private linking conference*
- *Allstar link transition from EchoLink began early in 2013*
 - *Linux based control*
 - *Better audio BW*
 - *EchoLink HUB also maintained as 'back door' when traveling*
 - *Main **927 HUB** is Allstar node **41170***
 - *Regional **South Texas HUB** is Allstar node **42610***



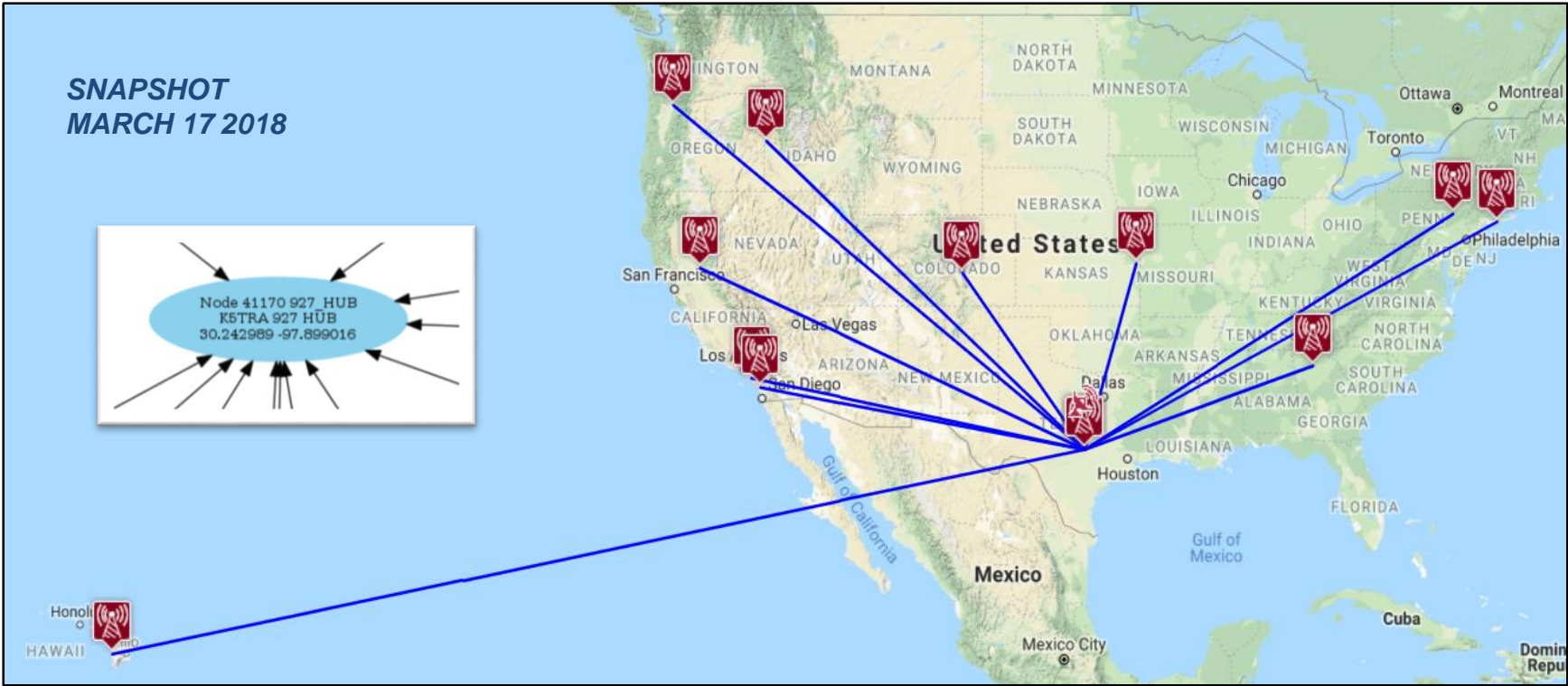
ELEVEN YEARS LATER

- Main 927 HUB
- South Texas HUB
- Northern CA HUB
- Southern CA HUB
- Portland HUB
- Idaho HUB
- Also connections from:
 - Kansas City
 - Atlanta
 - Long Island
 - Colorado
 - Arizona
 - Hawaii



Altair Link [surrounding node 4170] status of 01/02/18 01:21:05 GMT

LINKED 900 MHz NETWORK MAP



INTERNET RADIO LINKING

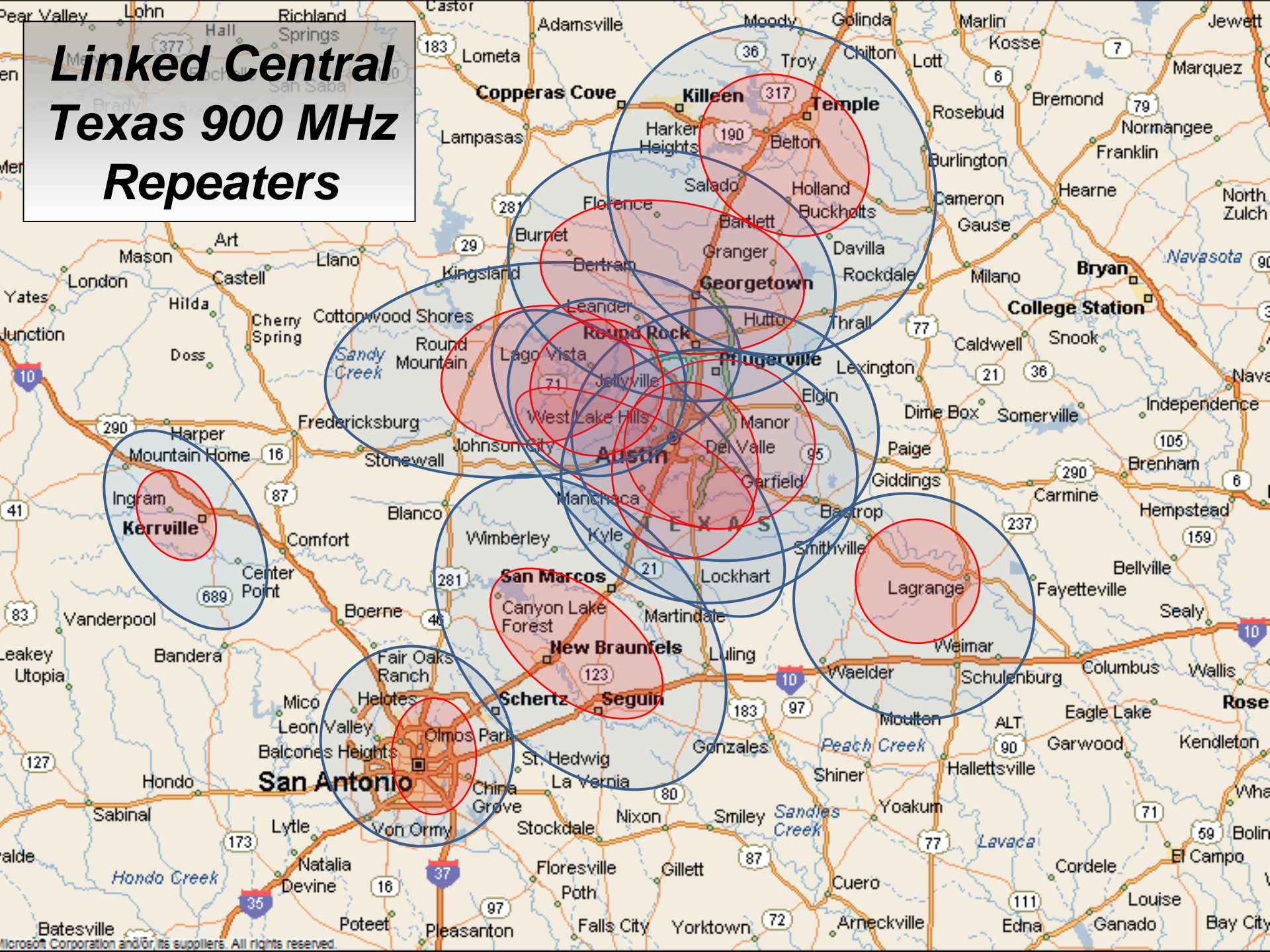
- Popular internet radio linking protocols:
 - EchoLink
 - IRLP
 - AllstarLink
- Commonality:
 - Peer to peer linking
 - Open ports required
- Differences:
 - Audio quality
 - Technical flexibility and customization
 - Stability

AllstarLink is built on Asterisk (an open source PBX)

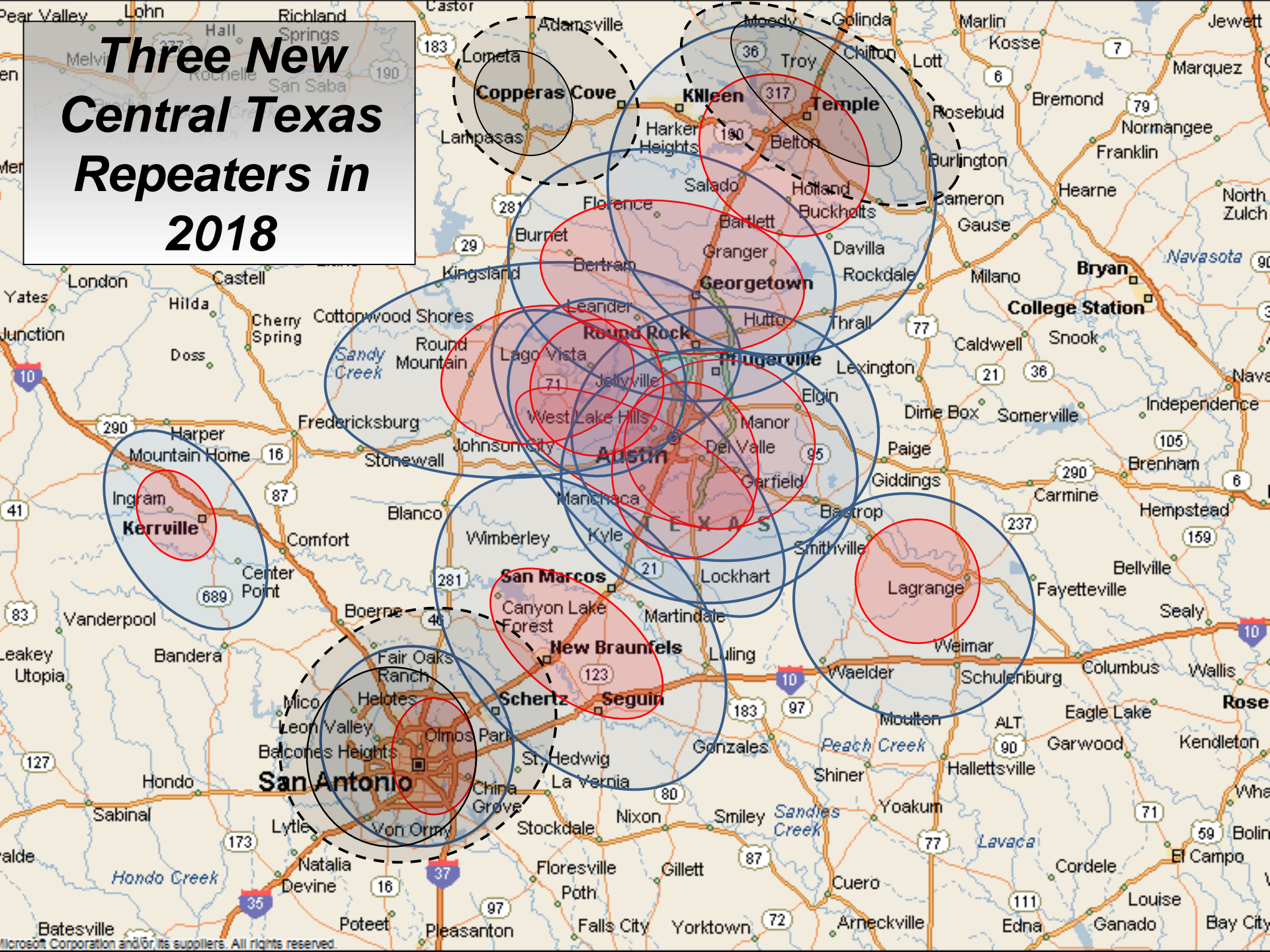
ALLSTARLINK IS PREFERRED

- Multiple codecs available depending on available BW
- Customizable DTMF functions and macros
- Commands can be activated by DTMF or remote login
- Shell scripts can be executed from DTMF commands
- Linux OS stability
- Server can be as simple/inexpensive as Raspberry Pi
- EchoLink can be added to the same server hardware
- IAX access can be added to the same server hardware

Linked Central Texas 900 MHz Repeaters



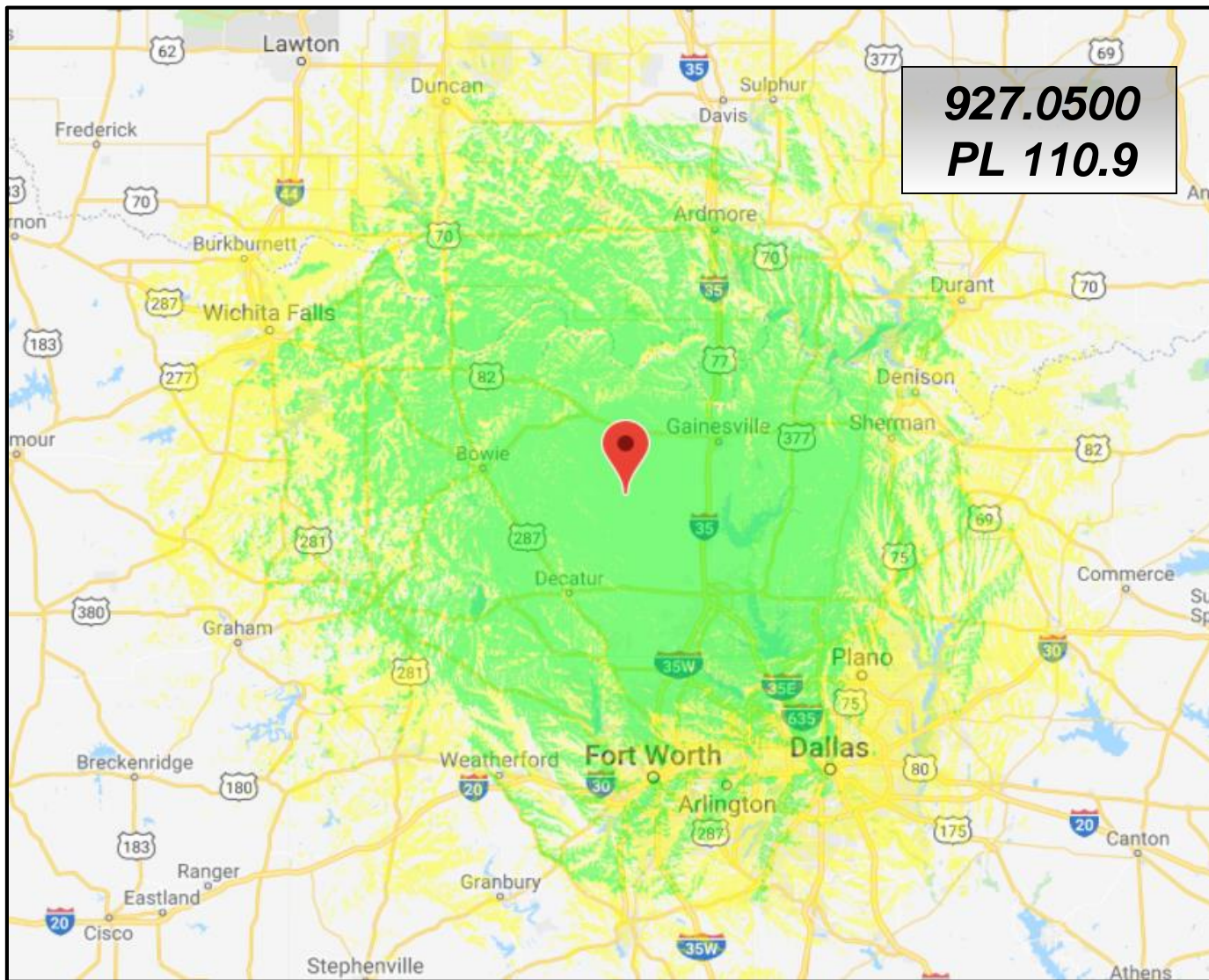
Three New Central Texas Repeaters in 2018



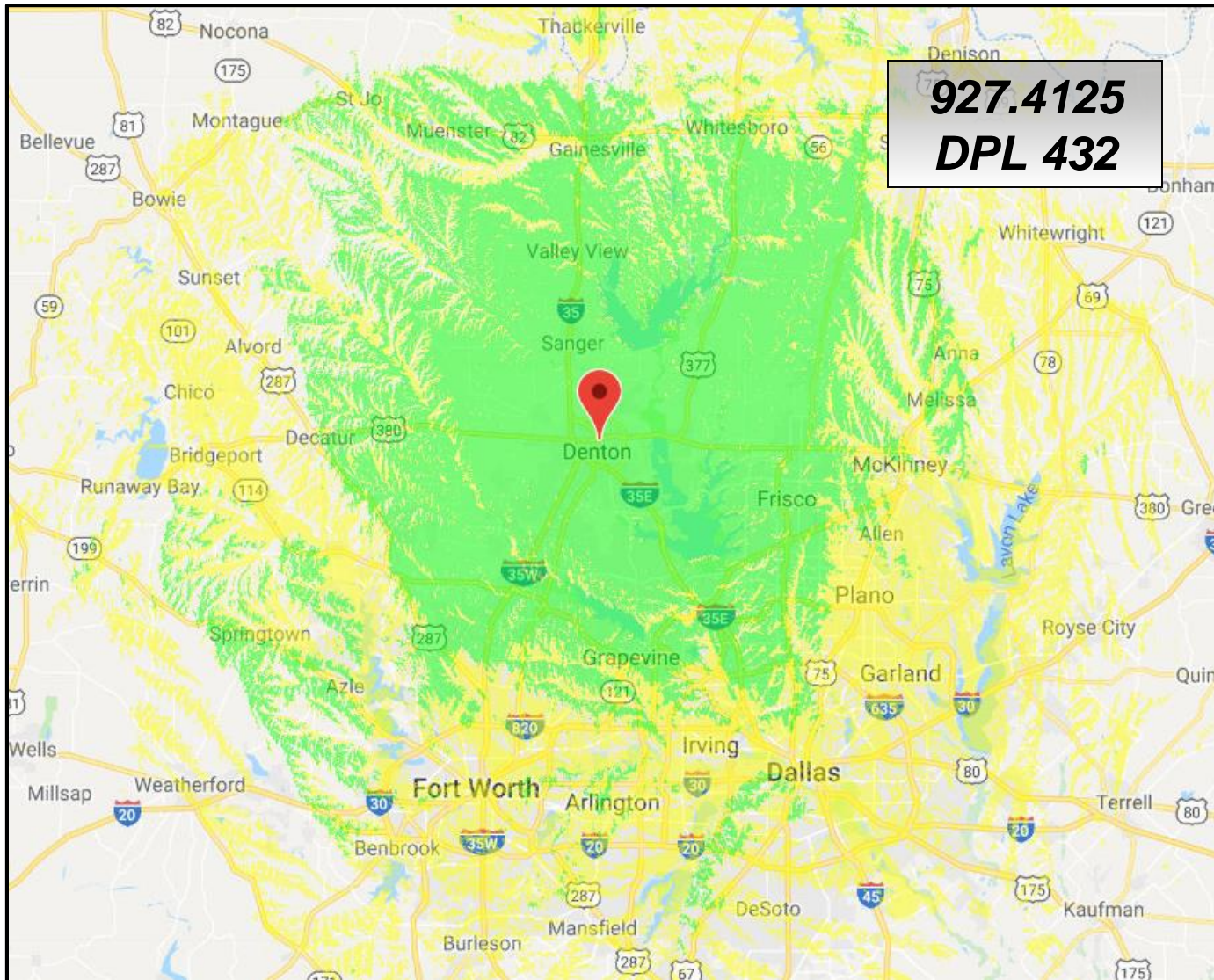
CENTRAL TEXAS 900 MHz LINKED REPEATERS

927.0125	TPL 225.7	Austin, TX (N) [<i>moved from 927.1375</i>]
927.0375	TPL 141.3	Canyon Lake, TX
927.0375	TPL 141.3	Troy, TX <i>WD4IFU REPEATER</i>
927.0500	TPL 110.9	Round Rock, TX <i>WD5EMS REPEATER</i>
927.0500	TPL 110.9	San Antonio, TX (NW)
927.0625	TPL 203.5	Georgetown, TX
927.0625	TPL 203.5	Katy, TX <i>N5TM REPEATER</i>
927.0750	TPL 218.1	San Antonio, TX (SE)
927.0750	TPL 218.1	Lampasas, TX <i>WD4IFU REPEATER</i>
927.0875	TPL 151.4	Bee Cave, TX
927.1125	DPL 432	Austin, TX (S)
927.1250	TPL 103.5	Lago Vista, TX
927.1500	TPL 114.8	Belton, TX <i>WD4IFU REPEATER</i>
927.1625	TPL 151.4	Kerrville, TX
927.1625	TPL 151.4	La Grange, TX
927.1750	TPL 110.9	Austin, TX (NW) <i>KA5D REPEATER</i>
927.1875	TPL 151.4	Austin, TX (Oak Hill)

ROSSTON TOWER - 900 MHz REPEATER



DENTON - 900 MHz REPEATER



900 MHz MOBILE RADIOS



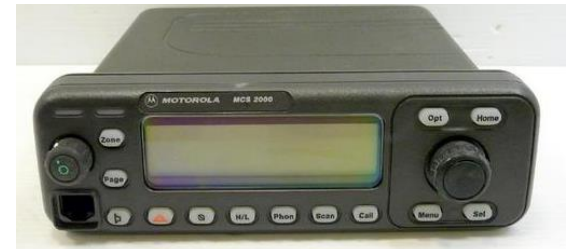
KENWOOD TK-981



MOTOROLA MCS-2000-3



KENWOOD TK-941



MOTOROLA MCS-2000-2



KENWOOD TK-931



MOTOROLA SPECTRA



MOTOROLA MCS-2000-1

**GOOD
CHOICES**

900 MHz PORTABLE RADIOS – GOOD CHOICES

GOOD CHOICES



**KENWOOD
TK-481**



**MOTOROLA
MTX-9250**



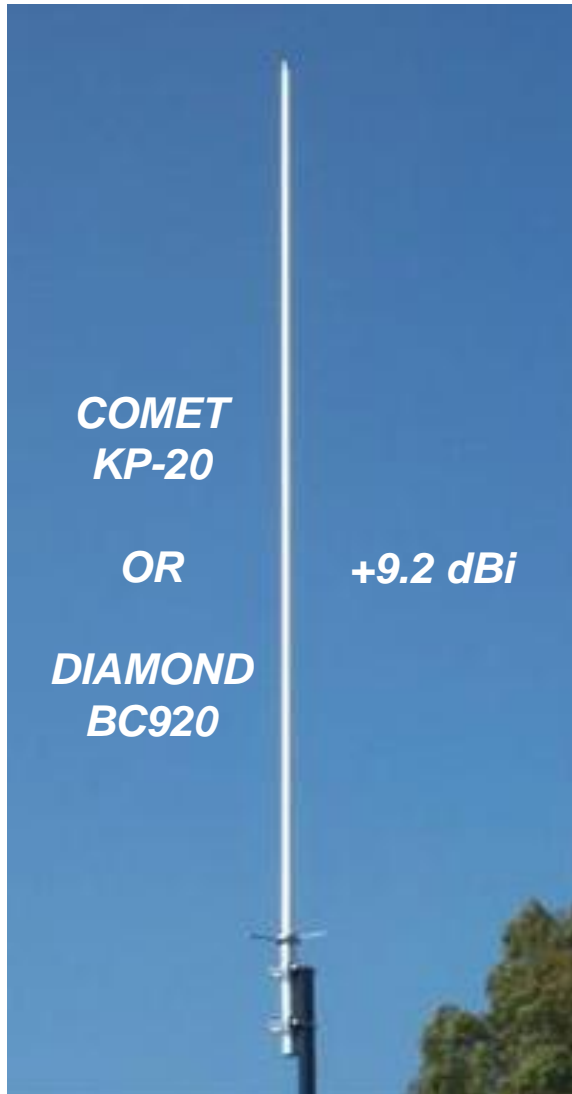
**ALINCO
DJ-G29**



**MOTOROLA
MTS-2000**

900 MHz ANTENNAS

BASE

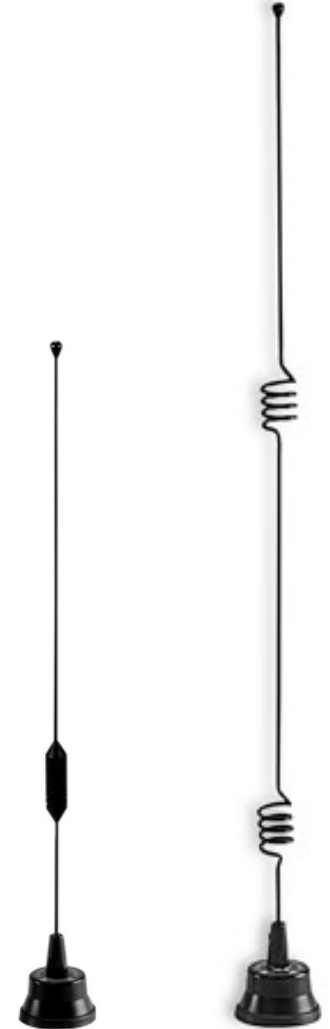


MOBILE



PHANTOM
ANTENNAS

LAIRD



NMO3E900B NMO5T900B
LARSEN

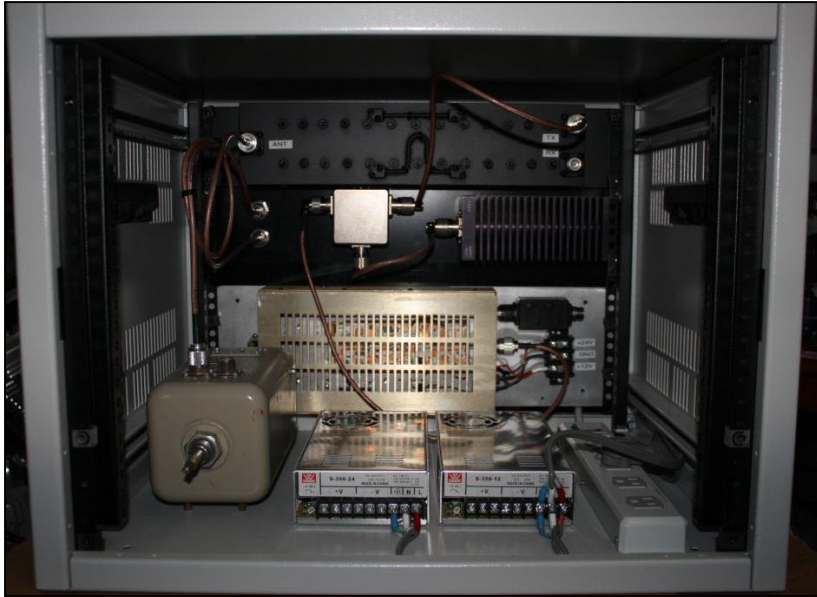
900 MHz BAND UTILIZATION

- In 1985 ARRL's band plan: 12 MHz split for FM repeaters
 - Not used due to available equipment limitations
- > 400 repeaters are 927 MHz – 902 MHz (25 MHz split)
- Weak signal SSB/CW and FM share the band very well
 - Both groups are populated by “Techies”
 - In many areas weak signal hams also have 900 MHz FM
 - High power repeater outputs are at 927 MHz (far from 902)
- Repeater inputs are in the 902 - 903 MHz
 - Some areas begin FM at 927.1125 (1st channel above 902.1)
 - Some share the lower 100 KHz
 - Noise floor often degrades above 902.2 MHz due to interference from spread spectrum transmitters that share the band

TYPICAL 900 MHz NOISE FLOOR

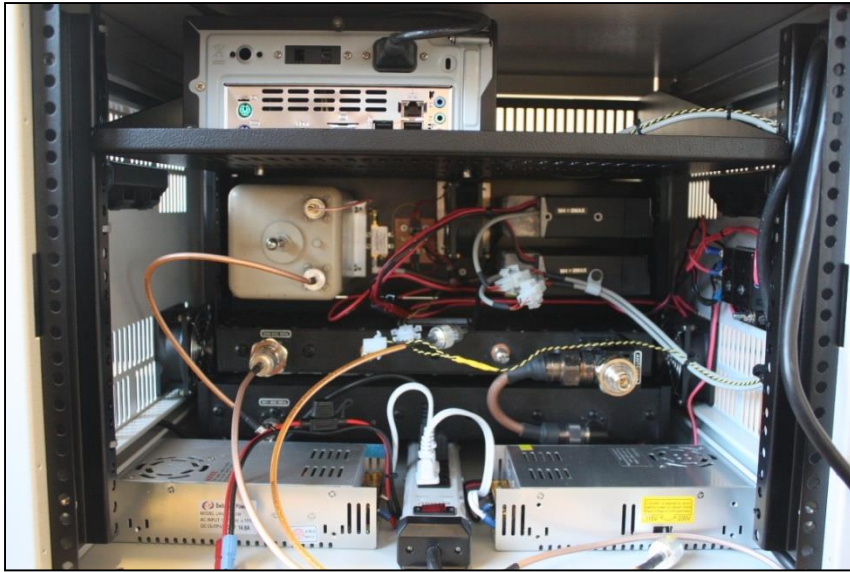


RF LINKED REPEATER



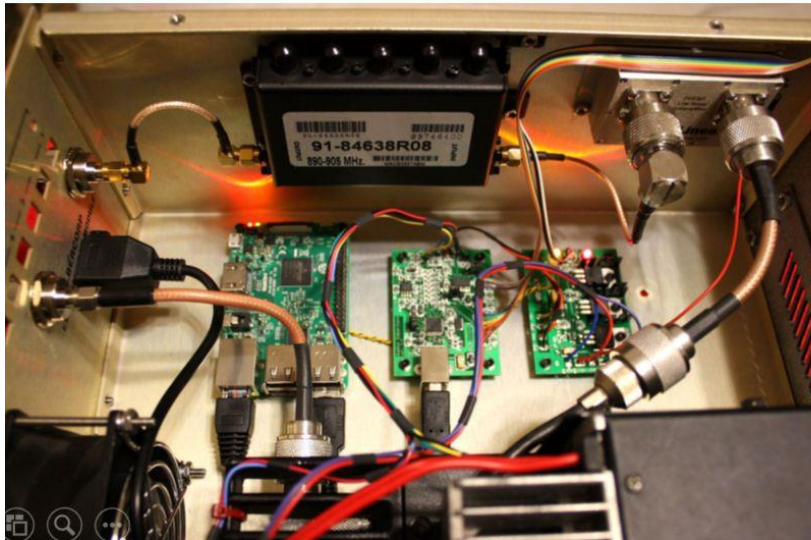
- TK-941 TX / RX and TK-840 Link
- Angle Linear LNA with Wacom preselector cavities
- Motorola 120W cellular PA (in TPL housing)
- Celwave Isolator
- Narda cellular combline duplexer
- ICS Linker-IIa controller

ALLSTAR LINKED REPEATER

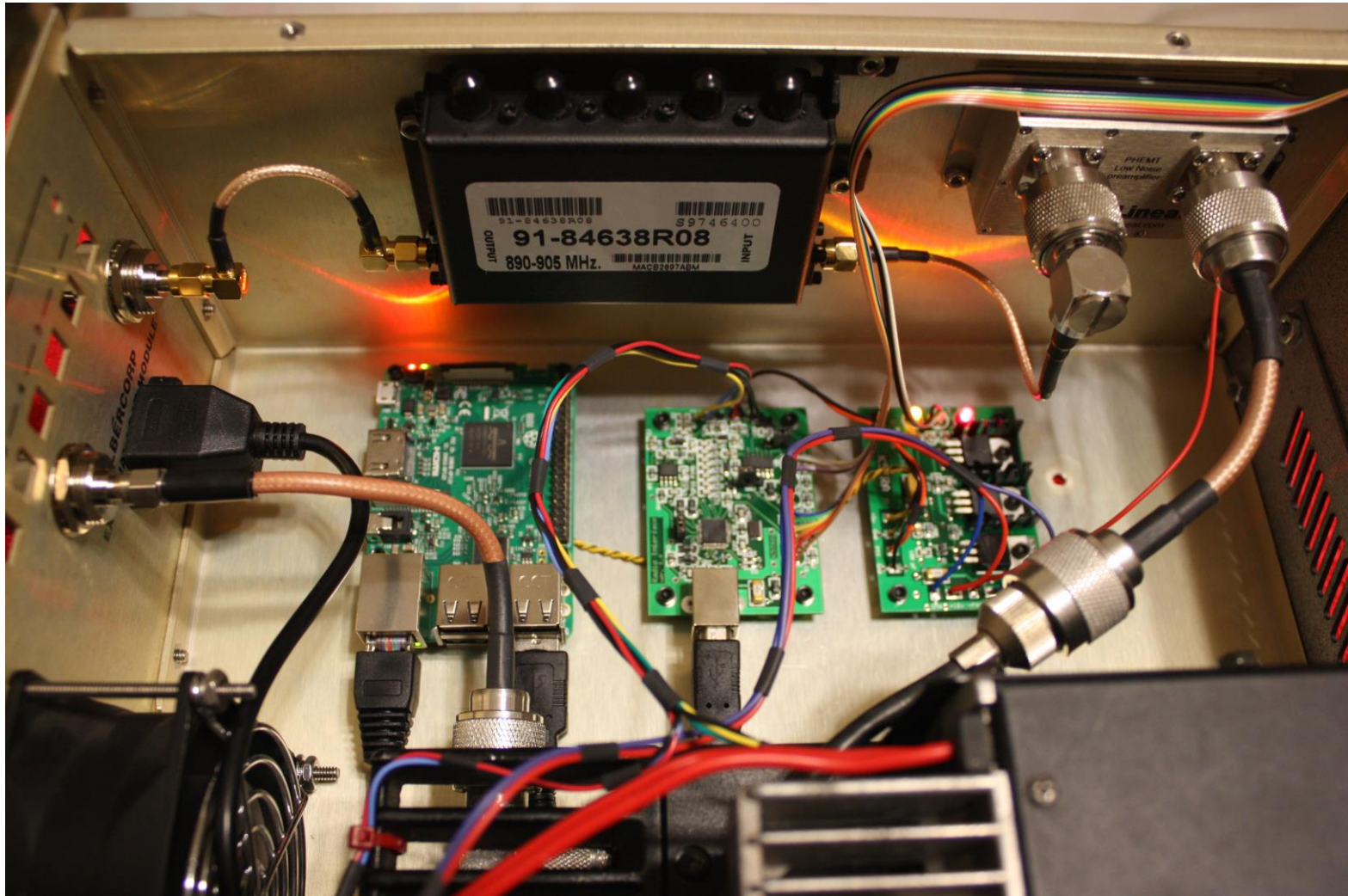


- TK-941 TX / RX and Linux Allstar Link (mini-ITX / SSD)
- Minicircuits LNA with Telewave preselector cavity
- GE MASTR-III 110W PA (w/ integrated isolator)
- WACOM combline duplexer
- **NO controller board: Allstar controller !**

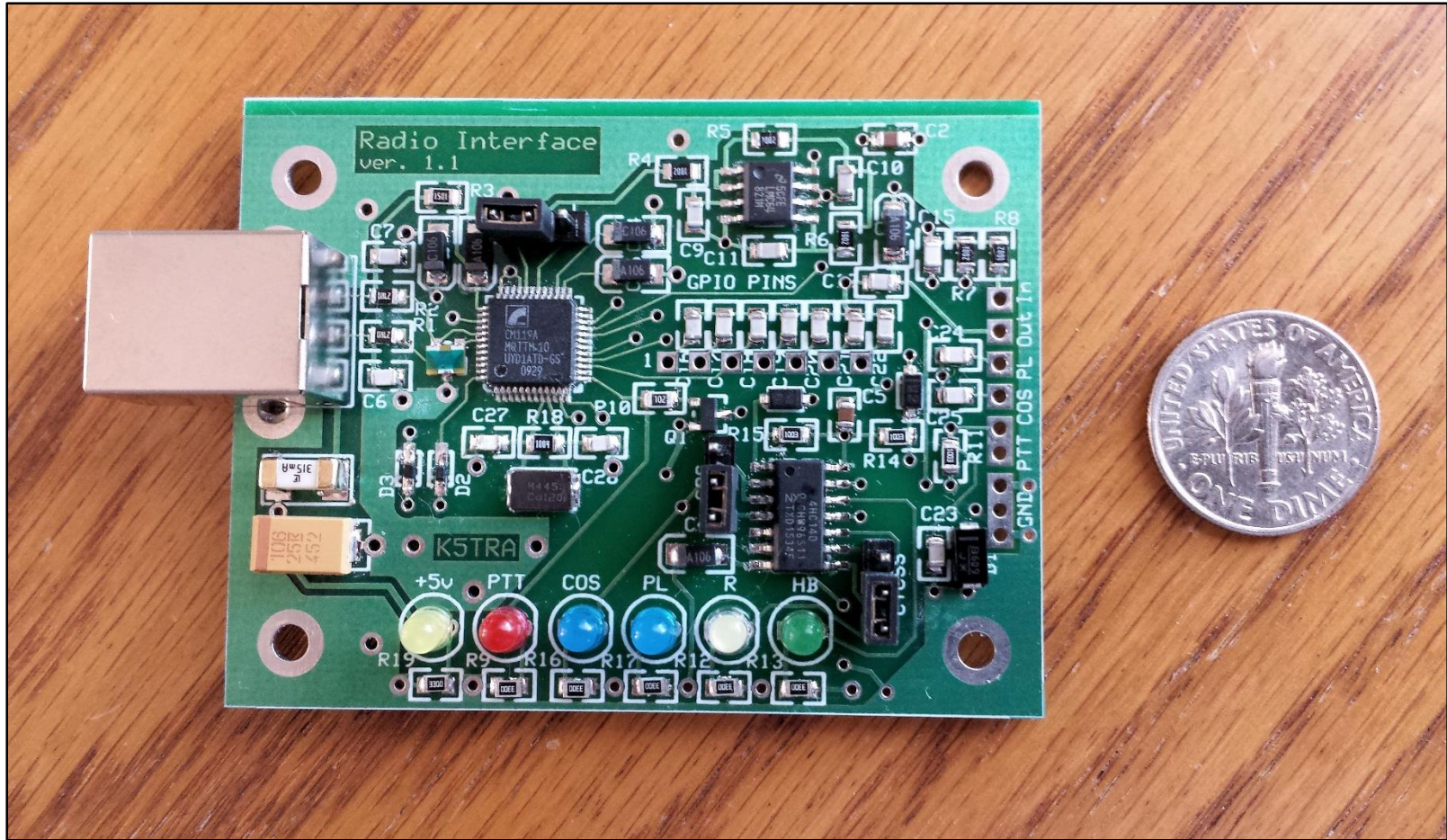
COMPACT ALLSTAR LINKED REPEATER



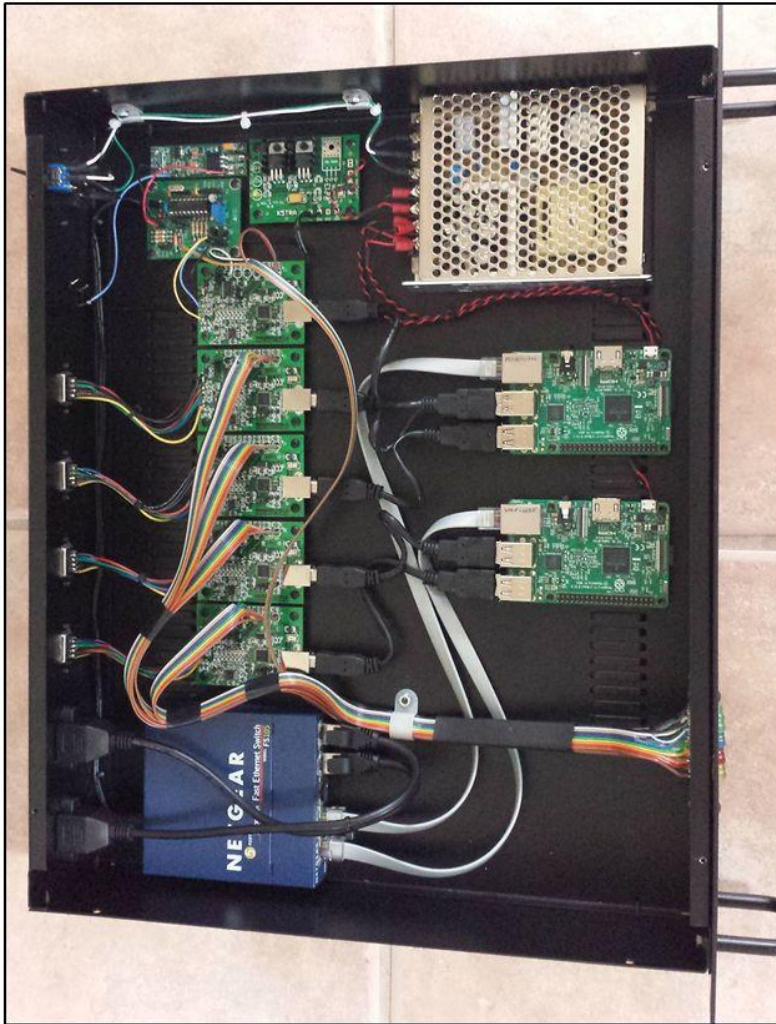
RASPBERRY Pi-3 CONTROLLER and ALLSTAR LINKER



ALLSTAR USB – RADIO INTERFACE



FOUR REPEATER CONTROLLER and ALLSTAR LINKER



LARCH MOUNTAIN SITE



SEPTEMBER 2008

*IN CENTRAL
TEXAS WE DON'T
HAVE MOUNTAINS*

LARCH MOUNTAIN SITE



*WE CAN GET TO OUR
SITES YEAR ROUND*

MARCH 2008

Looking to Portland and Salem from Larch Mountain

<http://k5tra.net>

