

927 MHz FM - 2014 UPDATE



K5TRA

Why 900 MHz ?

- 900 MHz is a new frontier for FM operation
- It is very much like 70 cm was 35 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's 900 MHz 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 higher (use low loss coax)

Some History

- *August 2007 I visited friends in W. Texas*
- *We talked about 900 MHz and plans for 902-HUB*
- *I returned to Portland 'stoked' to get on 900 MHz*
- *My 1st repeater was operational in 2007 (Portland)*
- *The 2nd machine on the air -March 2008 (Larch Mountain SW Washington)*

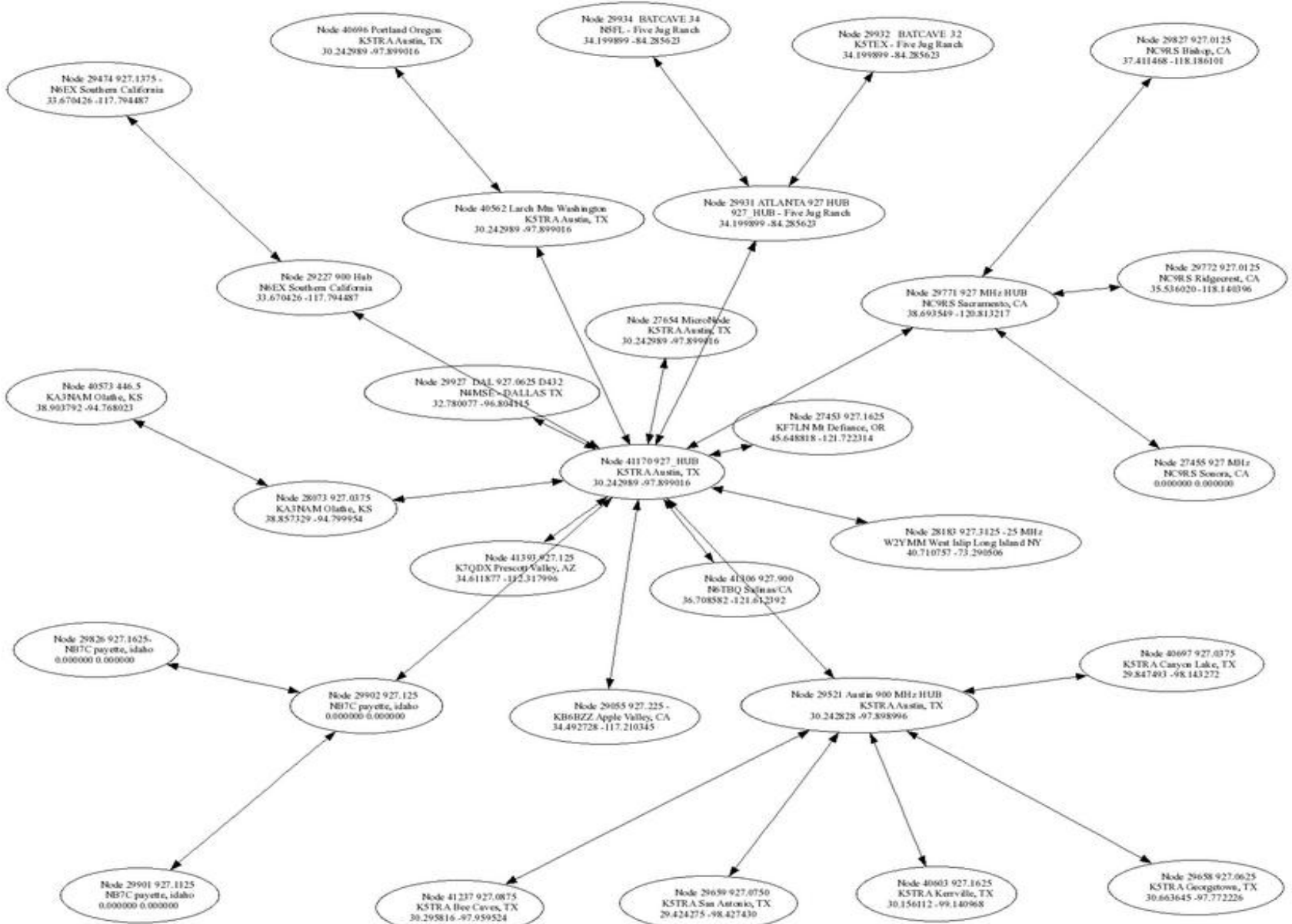


Seven Years Later

- *902 HUB was formed 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 902 HUB*
- *Austin based **927 TECH** linking HUB began in 2011*
 - *Many 900 MHz repeaters migrated from 902 HUB*
 - *EchoLink private linking*
- *Allstar link added early in 2013*
 - *Linux based control*
 - *Better audio BW*
 - *Many 900 MHz repeaters migrated to Allstar from EchoLink*
 - *EchoLink HUB also maintained*
 - ***927 HUB** is Allstar node 41170*



Allstar 927 HUB Linking



Allstar Link [surrounding node 29521] status of 11/11/14 07:18:58 GMT

EchoLink 927 TECH Linking

The screenshot shows the EchoLink software interface for station K5TRA. The window title is "EchoLink - K5TRA". The menu bar includes "File", "Edit", "Station", "Tools", "View", and "Help". The toolbar contains various icons for connecting, disconnecting, and managing stations.

The main window displays "5,261 stations on nasouth.echolink.org (15% are busy)". On the left, a tree view shows "Locations", "Node Types", "Alarms (26)", "New", and "Favorites (16)". The "Alarms" folder is selected.

The central pane shows a list of stations with columns for "Station" and "Location/Description". The station "*927_TECH*" is highlighted, indicating it is the current conference.

Station	Location/Description
902_HUB	Private conference [0/15]
927_TECH	Private conference [5/25]
CARE_HUB	Technology & Social [3/25]
ECHOTEST	Audio test server
HI-GATE	"IRLP REF 9250" [11/500]
OPENIRLP	See openirlp.net. [4/100]
K5TRA-L	In Conference *CARE_HUB*
K5TRA-R	In Conference *927_TECH*
K7QDX-R	Private conference
KA3IDN-R	Odessa TX
KA7ANM-R	off
KD8USF-R	In Conference KA5PQK-R
KF7LN-R	off
KW7HAM-R	In Conference *927_TECH*
N3TOY-R	In Conference IRLP 9228
N6EX-R	off
NA7Q-R	off
NB7C	motorola XT907 User
NB7C-L	off
NB7C-R	SW Idaho
NC9RS-R	off
NV4AA-L	off
W3HZL-R	off

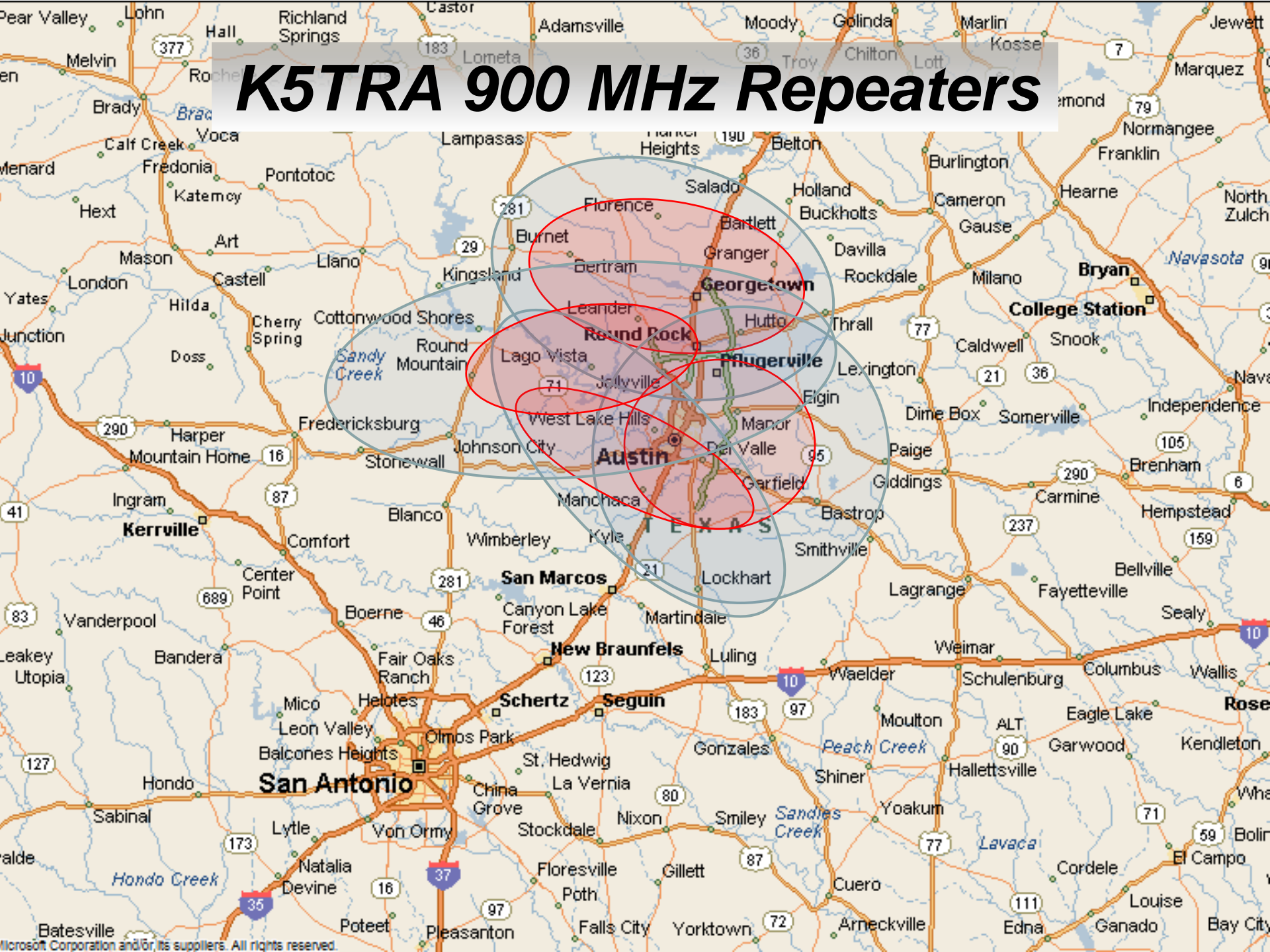
The right pane displays conference details for "CONF *927_TECH* hosted by: K5TRA & N7GLV [6/25]". The details include:

- K5TRA Tom
- K5TRA-R Allstar 29521
- K9KEA-R SE WI SCMC
- KW7HAM-R Portland Area
- K7QDX-R
- KD6VPH-L Olympia, WA

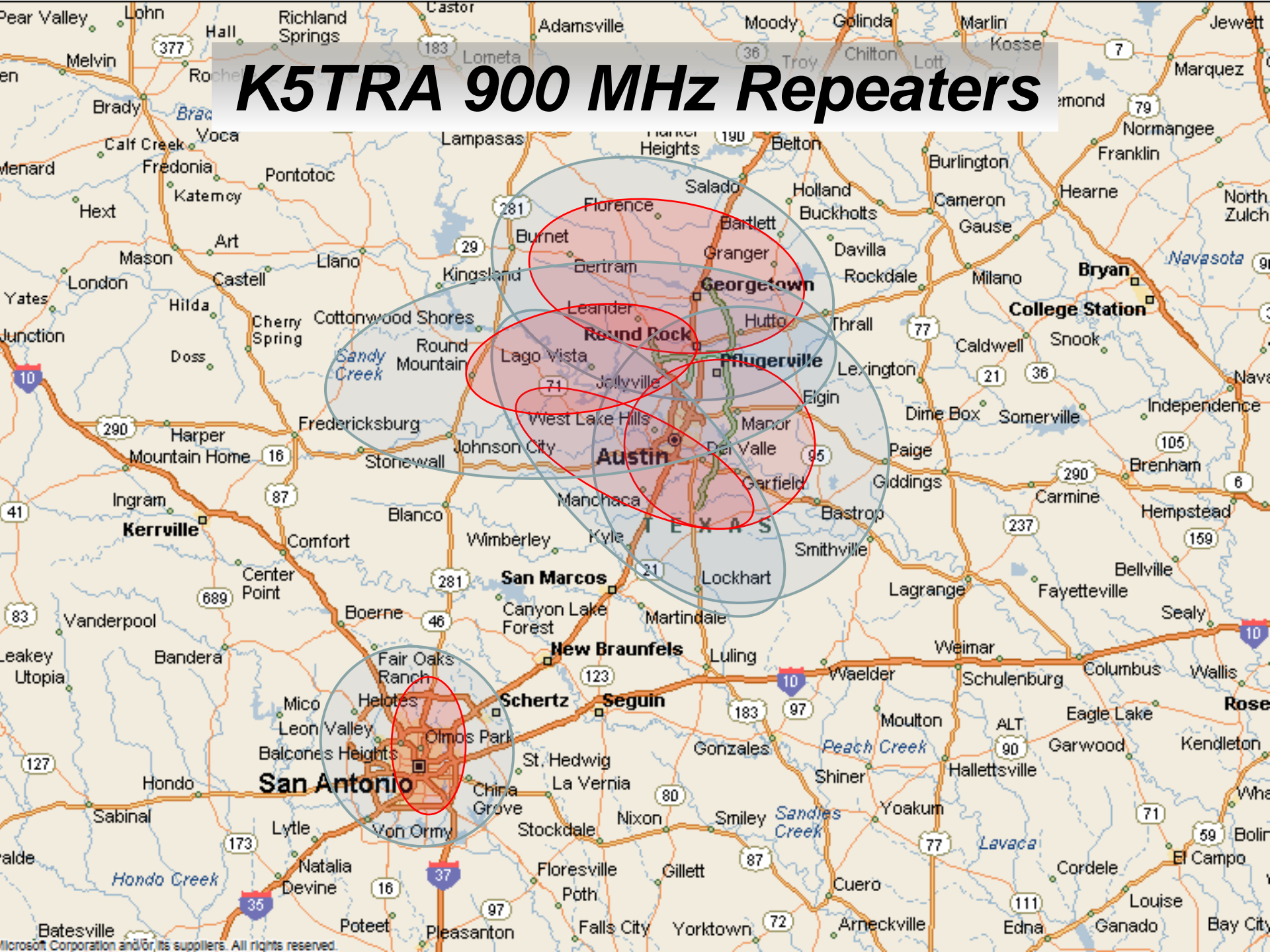
Additional information: "927 MHz Conference", "33cm, 23cm, and microwave technology interest", and contact info: "Contact tom@k5tra.net or 512-686-3689 for more info."

The bottom status bar shows "Connected to: *927_TECH* (Conference [5/25]) CONF" and "927-tech.pnwx.com". The status is "Ready" and "Connected".

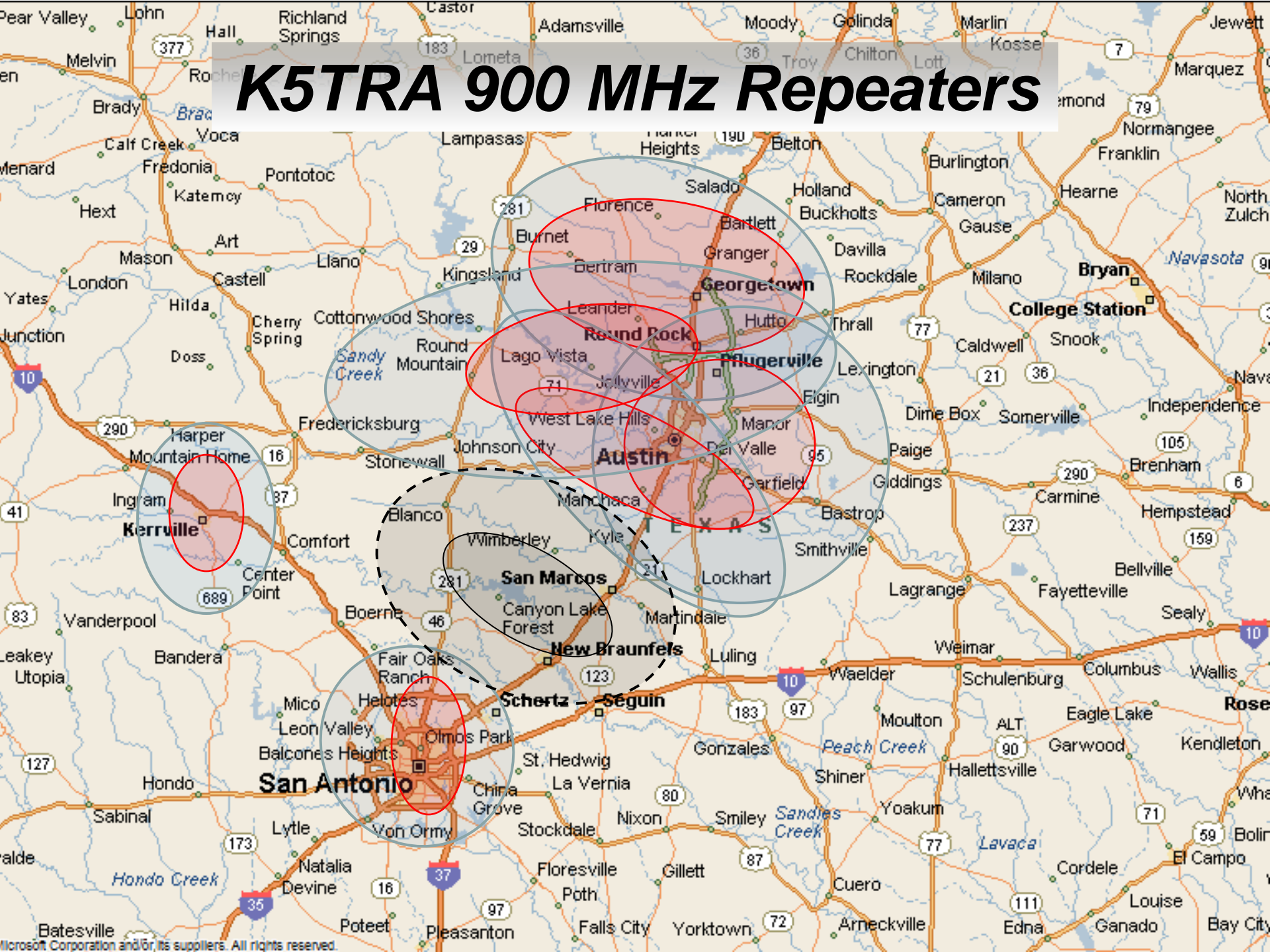
K5TRA 900 MHz Repeaters



K5TRA 900 MHz Repeaters



K5TRA 900 MHz Repeaters



Austin Area 900 MHz Repeaters

- *Canyon Lake*
 - *100W, 927.0375, PL 141.3*
 - *Allstar 927 HUB Linked*
- *Georgetown*
 - *100W, 927.0625, PL 203.5*
 - *Allstar 927 HUB Linked*
- *San Antonio*
 - *100W, 927.0750, PL 218.1*
 - *Allstar 927 HUB Linked*
- *Austin -Southwest*
 - *100W, 927.1125, DPL 432*
 - *Allstar 927 HUB Linked*
- *LagoVista*
 - *100W, 927.1250, PL 103.5*
 - *Allstar 927 HUB Linked*
- *Austin -North Central*
 - *100W, 927.1375, PL 131.8*
 - *Allstar 927 HUB Linked*
- *Kerrville*
 - *15W, 927.1625, PL 151.4*
 - *Allstar 927 HUB Linked*
- *6M & DX link to Calif.*
 - *15W, 927.1875, PL 151.4*
 - *NOT linked to 927 HUB*
- *Belton (NU5D).*
 - *15W, 927.5000, PL 100.0*
 - *NOT linked to 927 HUB*

Austin linked repeaters are 100 W capable



900 MHz Mobile Radios



KENWOOD TK-981



MOTOROLA MCS-2000

GOOD CHOICES



KENWOOD TK-931



MOTOROLA SPECTRA

POOR CHOICES



KENWOOD TK-941



MOTOROLA MAXTRAC



MOTOROLA GTX

900 MHz Portables

GOOD CHOICES

POOR CHOICES



**MOTOROLA
MTS-2000**



**KENWOOD
TK-481**



**MOTOROLA
MTX-9250**



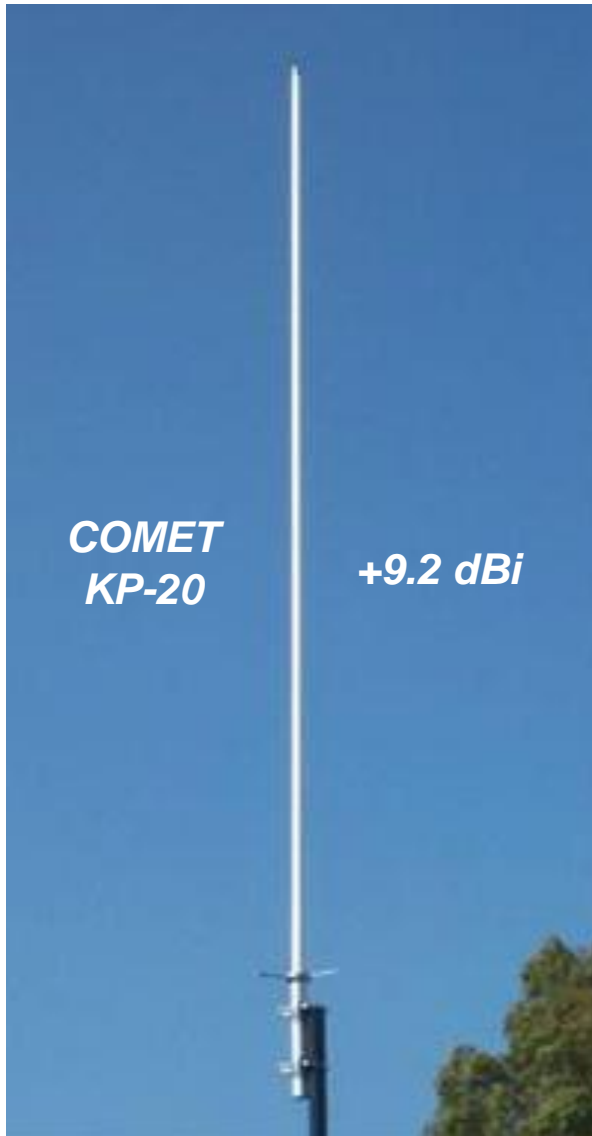
**MOTOROLA
GTX**



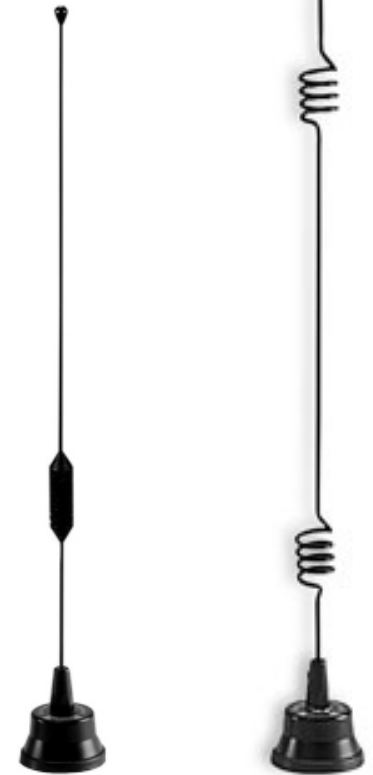
**KENWOOD
TK-431**

900 MHz Antennas

BASE



MOBILE



Current US 900 MHz Band Utilization

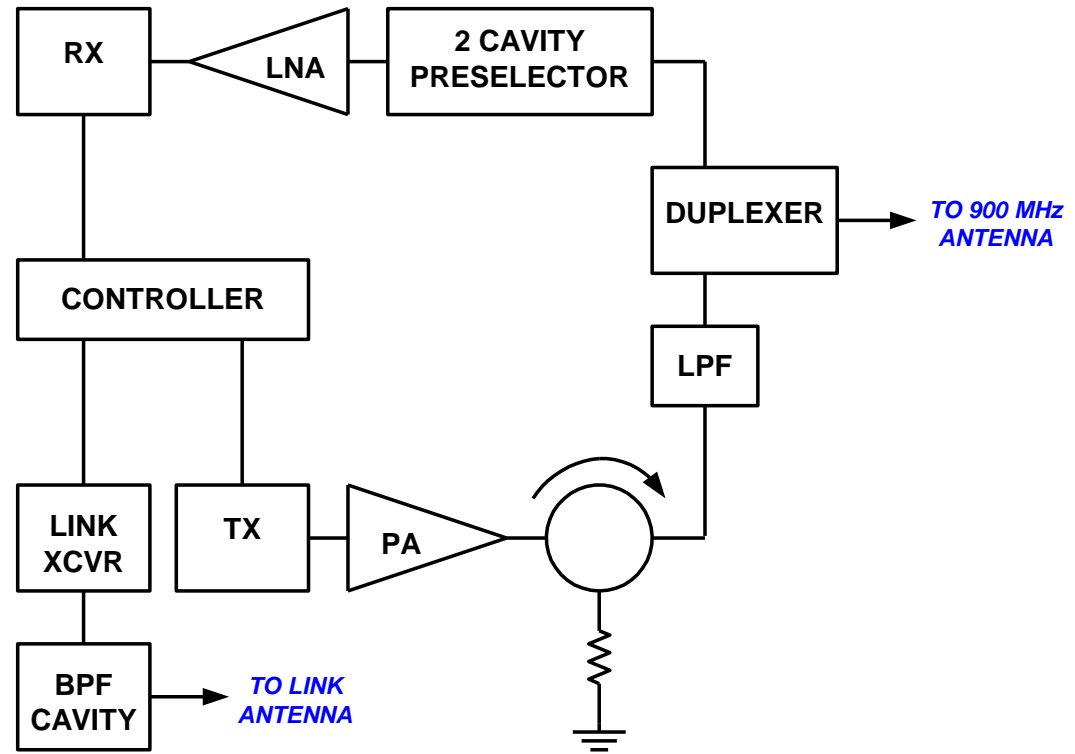
- In 1985 ARRL's band plan: 12 MHz split for FM repeaters
 - Not used due to available equipment limitations
 - Approx. 300 repeaters are 927 MHz – 902 MHz (25 MHz split)
- Weak signal SSB/CW and FM share the band very well
 - Both groups are populated by “Techies”
 - In many areas weak signal hams also 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

900 MHz Noise Floor



Austin Repeater Configuration

- **Duplexer:** Cellular base station
 - dual combine
- **Preselector:** Wacom cavities
- **LNA choices**
 - Angle Linear
 - Minicircuits
 - ARR
- **TX and RX:** TK-941
- **Link**
 - TK-840 -or-
 - Linux / Allstar with URI
- **Controller:** ICS Linker II
- **PA:**
 - Motorola cellular 150W -or-
 - GE MASTR-III 100W
- **Isolator & load:** Celwave
- **Power Supplies (switching)**
 - Meanwell (SE-600-12)
 - Meanwell (SE-600-24)



Antennas

- North Central: SCALA OGB-9
- Southwest: SCALA OGB-9
- Lago Vista DB-806
- Georgetown: SCALA OGB-9
- SanAntonio DB-589
- Kerrville Comet KP-20

902 MHz / 927 MHz Duplexer



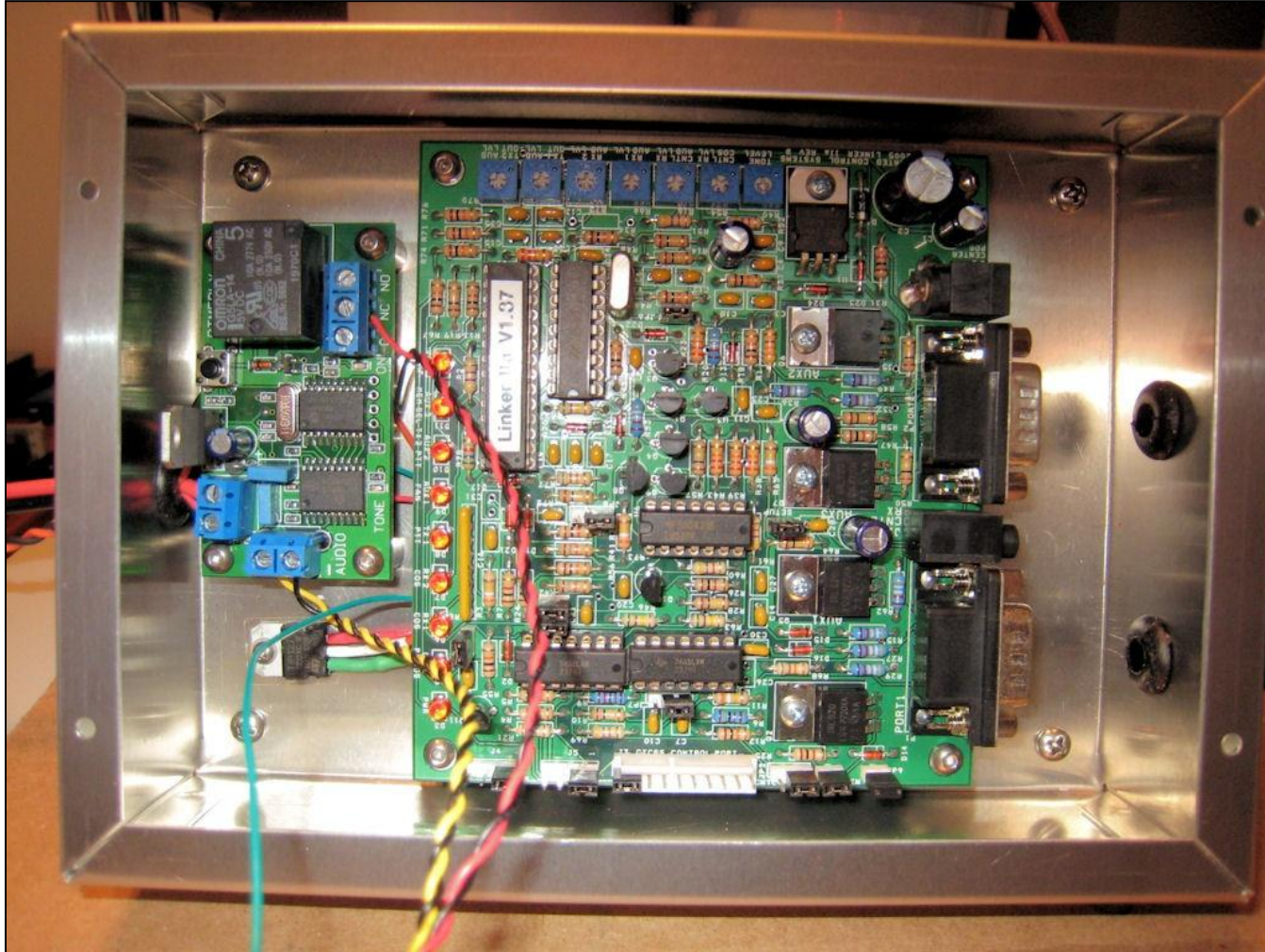
COMBLIN DUPLEXER
from CELLULAR BASE STATION

USED IN AUSTIN MACHINES

902 MHz LNA and Preselector Filter



Controller and DTMF Relay



TX/RX Stacks

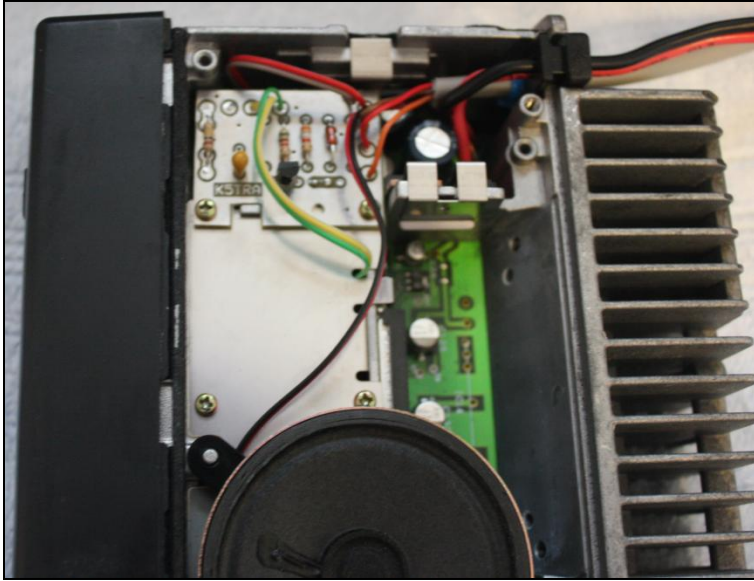


TK-941 panel

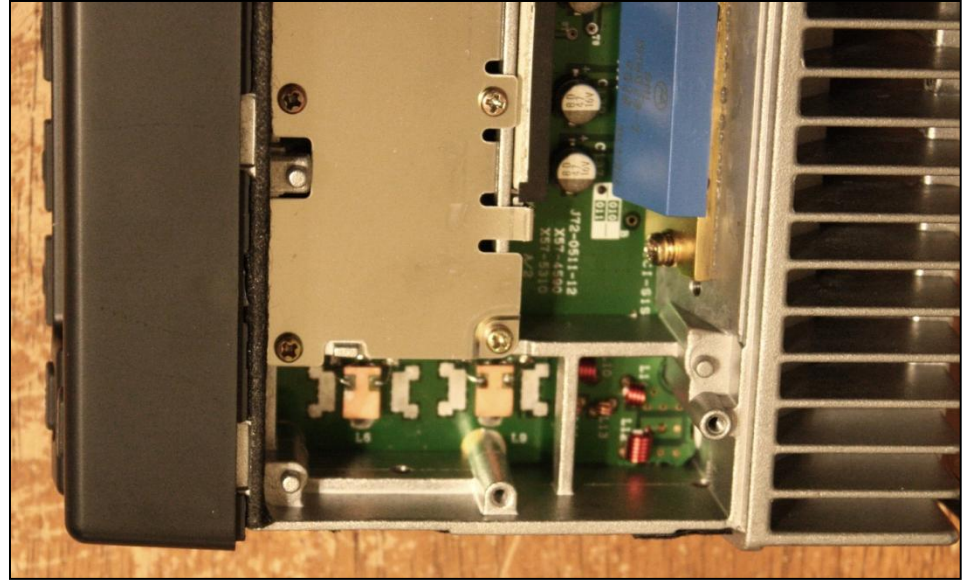


TK-931 panel

TK-941 Receiver Mods



COS buffer-invert

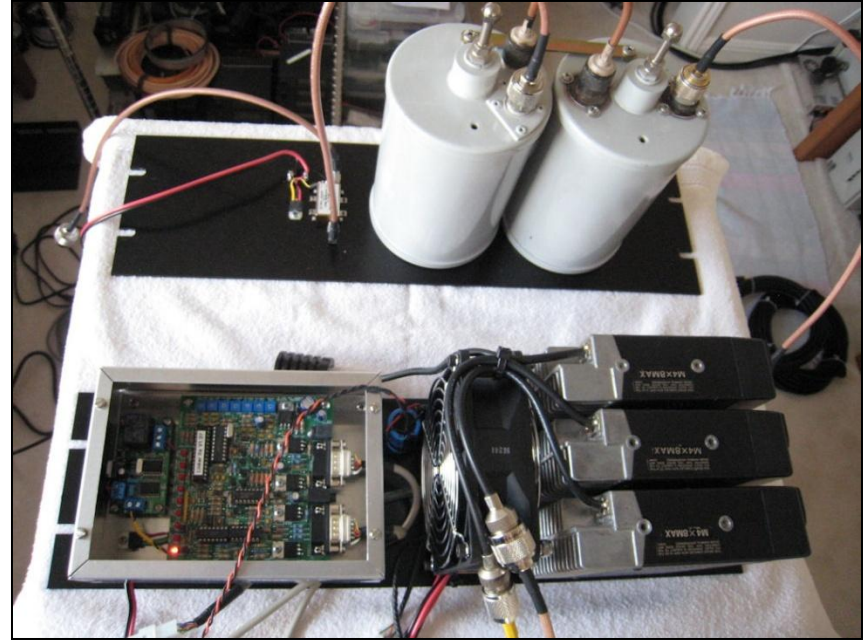


RX filter change

Radios, Controller, LNA & Preselector

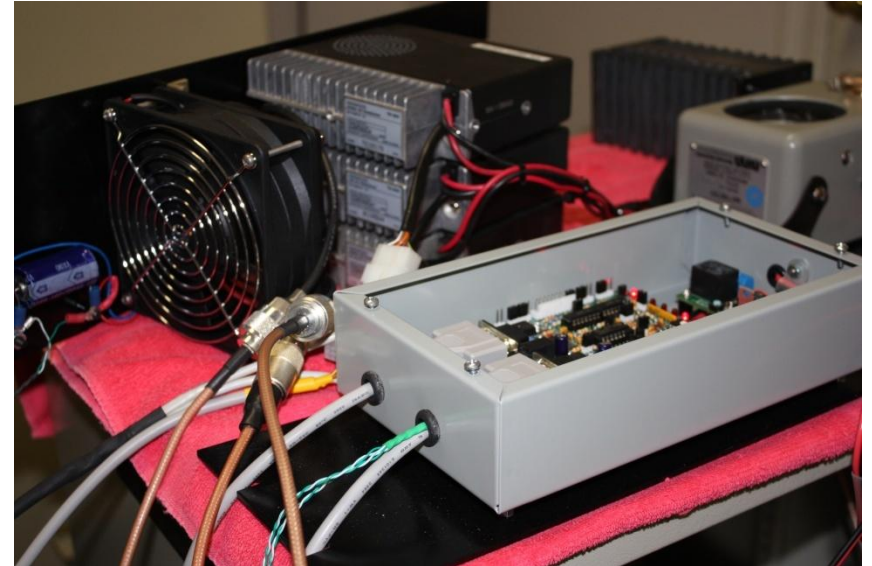
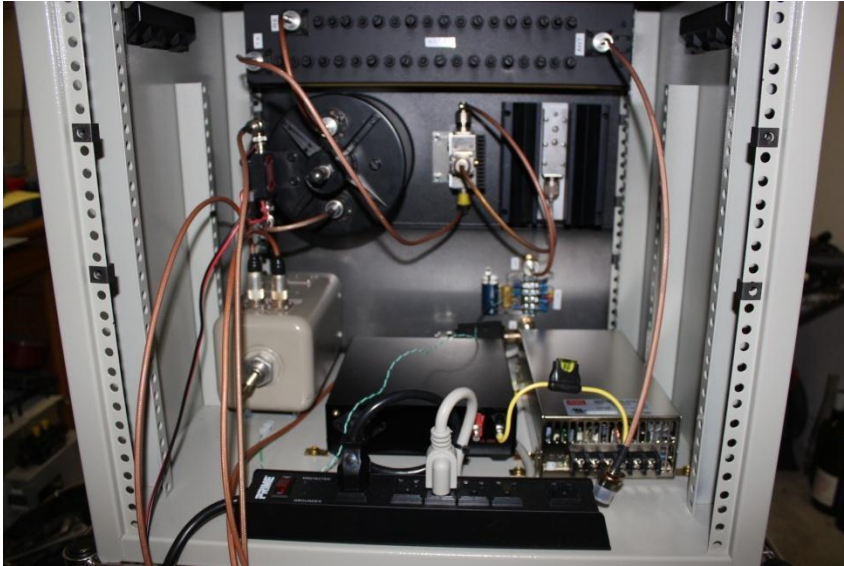


SW Austin repeater



Lago Vista repeater

North Austin Repeater



- TK-941 TX / RX and TK-840 Link
- ARR LNA with Celwave preselector cavity
- Motorola 120W cellular PA
- Celwave Isolator
- Narda cellular combline duplexer
- ICS Linker-IIa controller

Southwest Austin 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

Lago Vista Repeater



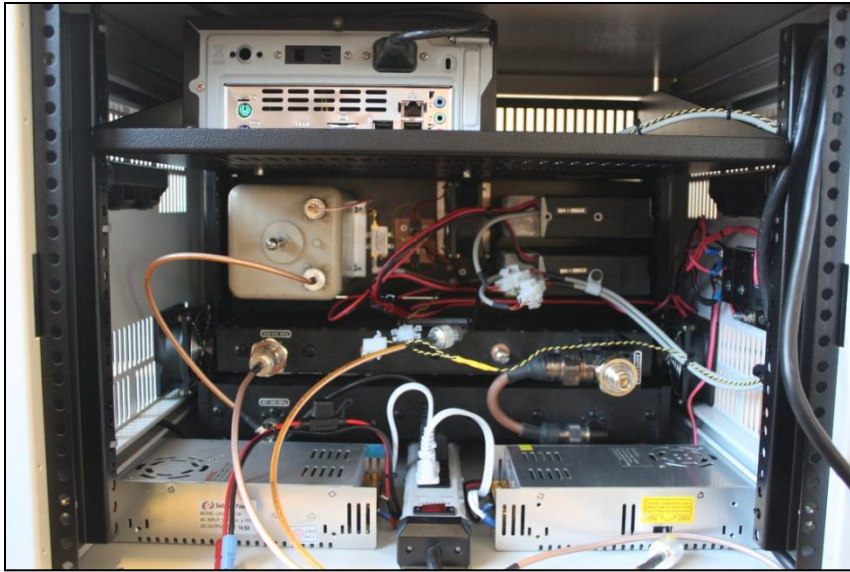
- TK-941 TX / RX and TK-840 Link
- Minicircuits LNA with Wacom preselector cavities
- Motorola 120W cellular PA
- Celwave Isolator
- Narda cellular combline duplexer
- ICS Linker-IIa controller

Georgetown Repeater



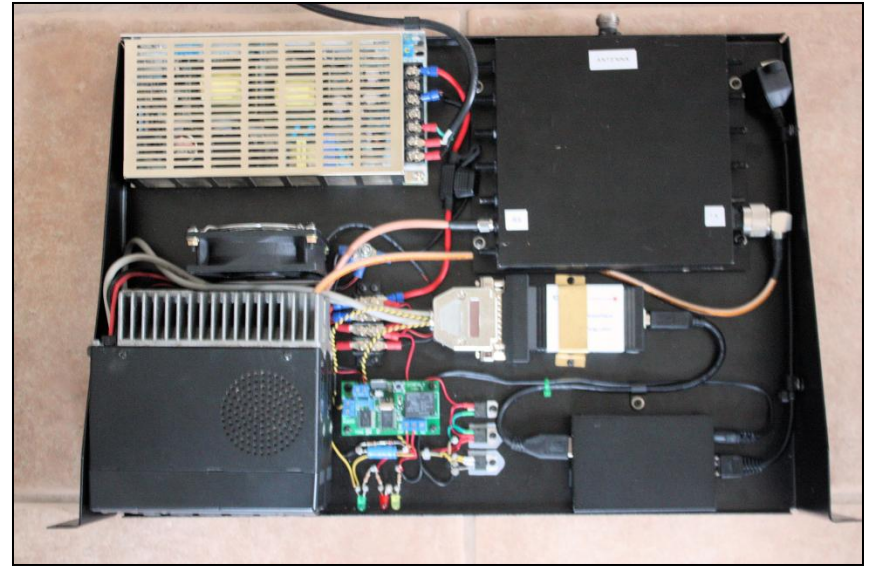
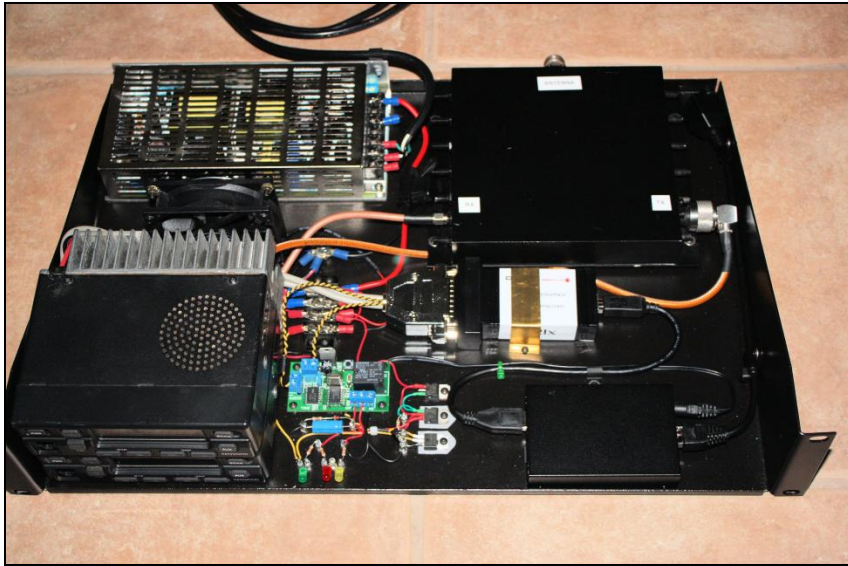
- TK-941 TX / RX and Linux Allstar Link (mini-ITX / SSD)
- Minicircuits LNA with Wacom preselector cavities
- GE MASTR-III 110W PA (w/ integrated isolator)
- WACOM combline duplexer
- ICS Linker-IIa controller

Canyon Lake Repeater



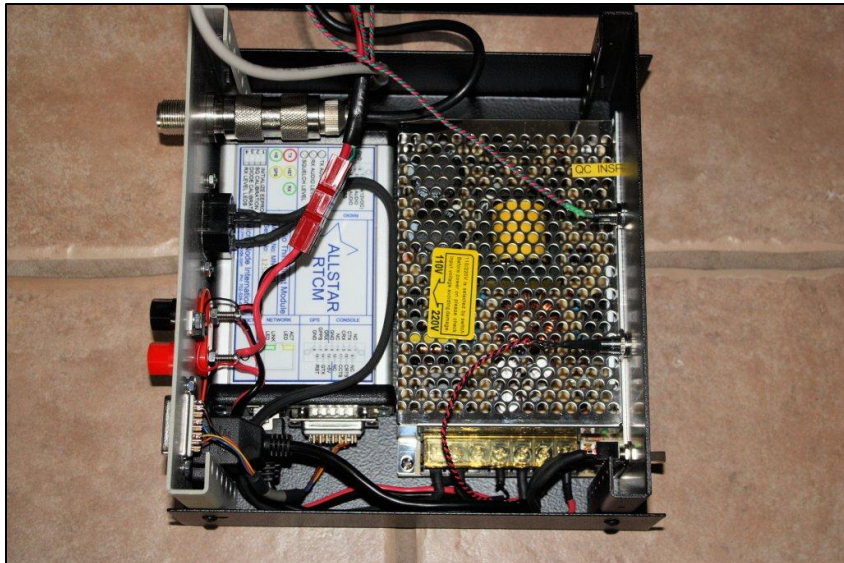
- TK-941 TX / RX and Linux Allstar Link (mini-ITX / SSD)
- Minicircuits LNA with Telewave preselector cavity
- GE MASTR-III 110W PA (w/ integrated isolator)
- WACOM combline duplexer
- NO controller board: Allstar controller !

Bee Caves Repeater

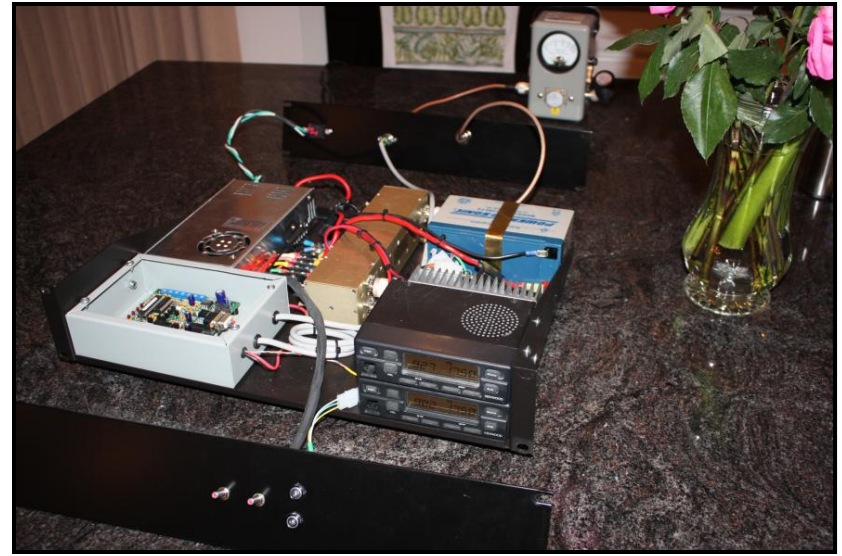
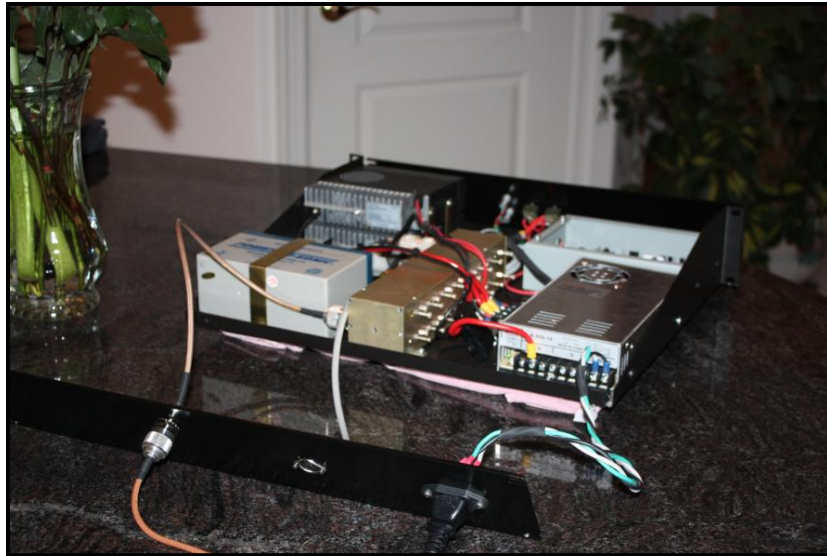


- TK-941 TX / RX
- Linux Allstar Link: Beaglebone Black Rev.C
- DMK USB radio interface
- K&L combline duplexer
- NO controller board: Allstar controller !
- ALL on 2U shelf !

K5TRA MicroNode



Portable 900 MHz Repeater



Some of the local 900 MHz Crew



Larch Mountain Site

SEPTEMBER 2008



Larch Mountain Site



MARCH 2008

Looking to Portland & Salem from Larch Mtn WA



More Information

- <http://k5tra.net>
- <http://k5tra.net/AllstarLink.html>
- <http://k5tra.net/33cm%20FM.html>