Fun With Satellites

Stories regarding a bunch of noobs that try to:

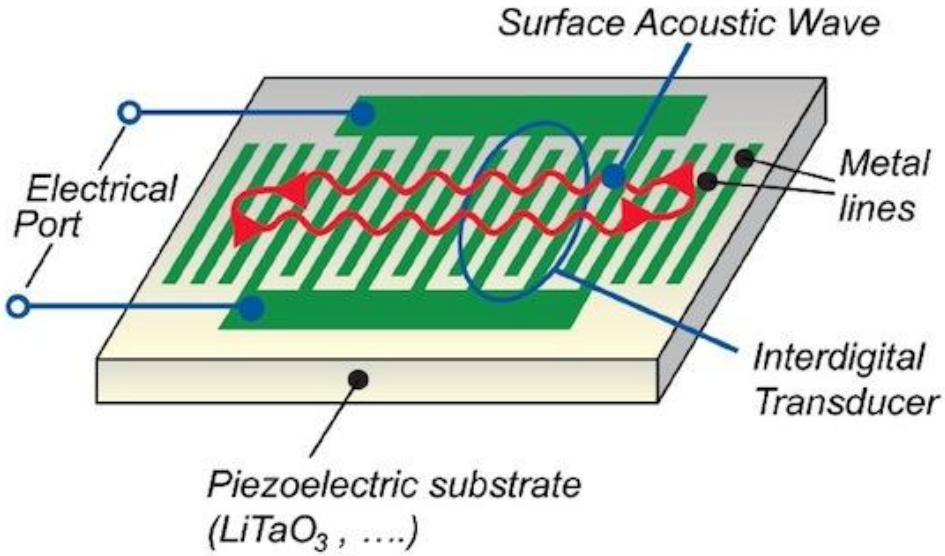
- **MAKE** a robotic UHF satellite tracking station (SatNOGS - work in progress :-)
- “**HACK**” Inmarsat STD-C EGC Messages (public shipping broadcast comms)
- **VOID** a GPS antenna’s warranty quite badly to listen to non-GPS satellites

make. hack. void

A Canberra Hackerspace

L-Band & cheap GPS antennas

- L-Band: 1-2GHz
- GPS frequency is 1575.42MHz
- SAW filters are cool[1]:
- What can we receive?
  www.uhf-satcom.com/lband/



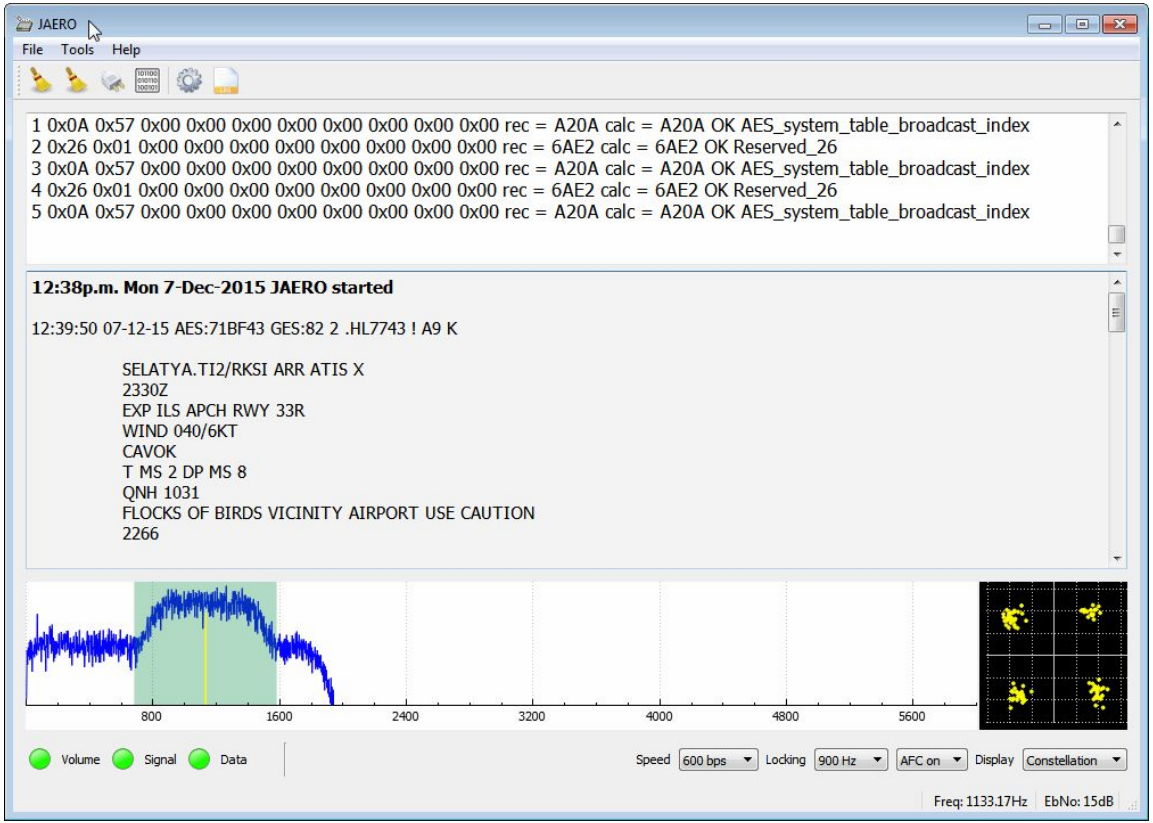
1: http://www.edn.com/design/wireless-networking/4413442/SAW--BAW-and-the-future-of-wireless

L-Band satellite frequencies (some of them!)

Position	Freq	Service / Modulation / Notes
98.14W	1525.870	BGAN 33.6 40kHz ACF=80.2ms
Inmarsat 4F3	1528.785	LES 360 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
(tnx to blh,)	1528.805	LES 360 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
(trango and)	1530.953	6Kbps BPSK weak
(r00t)	1531.240	BGAN ~100kHz weak
	1531.710	LES 056 Local=2 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1531.750	LES 253 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1531.770	LES 254 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1531.790	LES 252 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1531.810	LES 054 Local=3 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1532.080	BGAN ~100kHz weak
	1533.215	LES 361 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1533.285	LES 361 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1533.615	6Kbps BPSK? weak
	1533.625	Std-B NCS
	1533.635	Std-M LES 0xBD
	1535.1375	Seastar DGPS point to multipoint BPSK 2438bps {id=0xC685 scr=0x5C08}
	1535.175	Veripos DGPS correction data BPSK 2438bps (High Power) {id=???? scr=0x1D2F}
	1536.900	BGAN ~160khz
	1537.0625	BGAN 8400bps QPSK
	1540.300	BGAN ~160khz
	1542.500	BGAN ~160khz
	1542.700	BGAN ~160khz
	1543.140	LES 252 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.160	LES 253 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.180	LES 054 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.185	BPSK 2498Bd 2240bit frame
	1543.205	LES 051 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.250	LES 056 Local=0 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.290	2400bps BPSK BURSTS
	1543.305	LES 053 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.310	3372bps QPSK - Inmarsat AMSC LES
	1543.350	LES 254 Local=3 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.379	2400Bpsk BURSTS
	1543.380	LES 052 Local=2 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.395	LES 054 Local=1 Joint NCS+TDM - private LES TDMA BPSK 1200bps
	1543.955	BPSK 2498Bd 2240bit frame
	1545.545	SkyFire DGPS 1200BPSK
	1546.840	3372bps QPSK - Inmarsat AMSC LES

http://www.uhf-satcom.com/lband/

Inmarsat AERO messages



http://www.rtl-sdr.com/jaero-a-new-rtl-sdr-compatible-decoder-for-inmarsat-aero-signals/

Inmarsat STD-C EGC MESSAGES messages

Military Operations: Live Firing Warning

STRATOS CSAT 4-AUG-2015 03:21:25 436322 SECURITE FM: RCC NEW ZEALAND 040300 UTC AUG 15 COASTAL NAVIGATION WARNING 151/15 AREA COLVILLE, PLENTY CUVIER ISLAND (REPUNGA ISLAND), BAY OF PLENTY 1. LIVE FIRING 060300 UTC TO 060500 UTC AUG 15 IN DANGER AREA NZM204. ANNUAL NEW ZEALAND NOTICES TO MARINERS NUMBER 5 REFERS. 2. CANCEL THIS MESSAGE 060600 UTC AUG 15 NNNN

Armed Robbery / Pirate Warning

NAVAREA XI WARNING NAVAREA XI 0571/15 SINGAPORE STRAIT. ARMED ROBBERY INFORMATION. 301845Z JUL. 01-04.5N 103-41.8E. FIVE ROBBERS ARMED WITH LONG KNIVES IN A SMALL UNLIT HIGH SPEED BOAT APPROACHED A BULK CARRIER UNDERWAY. ONE OF THE ROBBERS ATTEMPTED TO BOARD THE SHIP USING A HOOK ATTACHED TO A ROPE. ALERT CREW NOTICED THE ROBBER AND RAISED THE ALARM AND CREW RUSHED TO THE LOCATION. HEARING THE ALARM AND SEEING THE CREW ALERTNESS, THE ROBBERS ABORTED THE ATTEMPTED ATTACK AND MOVED AWAY. INCIDENT REPORTED TO VTIS SINGAPORE. ON ARRIVAL AT SINGAPORE WATERS, THE COAST GUARD BOARDED THE SHIP FOR INVESTIGATION. VESSELS REQUESTED TO BE CAUTION ADVISED.

http://www.rtl-sdr.com/rtl-sdr-tutorial-decoding-inmarsat-std-c-egc-messages/

Iridium pager traffic

Sub-type 2: SMS

- 09.01 contains SMS
- Tested with leased Iridium phone: Iridium 9555

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0901 8f.01.01.07.91.88.61.26.09.00.50.00.83.24.0e.80.00.88
.61.26.99.00.00.20.00.51.01.51.91.73.12.00.7e.c4.b2.1c.a4.ad
.9f.c3.ee.33.48.5f.07.0d.df.6d.78.9d.5e.96.bb.41.75.37.19.14
.66.b3.cb.6d.16.e8.1e.9e.83.ca.69.77.b9.0d.d2.97.d3.e7.b2.1b
.b4.0e.bb.dd.2c.d0.3d.5d.06.91.d3.e5.79.19.74.2d.b3.e9.20.73
.dd.bd.a6.a7.df.ee.74.59.4e.67.81.e6.6f.36.9b.5e.06.d5.dd.e2
.f2.59.5e.76.eb.e9.a0.ba.9b.0c.b2.bf.d9.ec.39.7d.ef.26.a7.cf
.a0.79.39.ed.76.01.00.00.00.00.00.00.00.00.00.00.00.00.00.00
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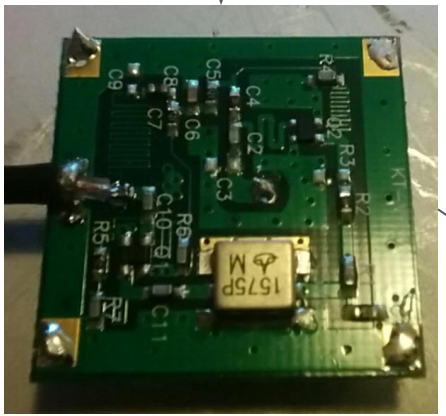
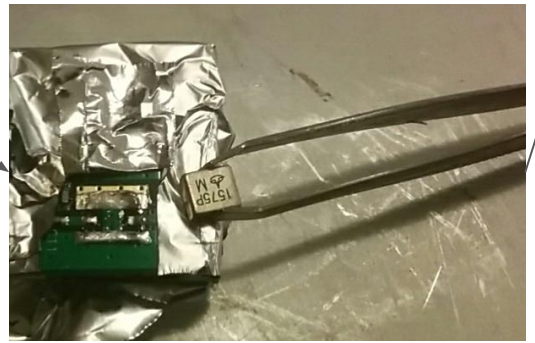
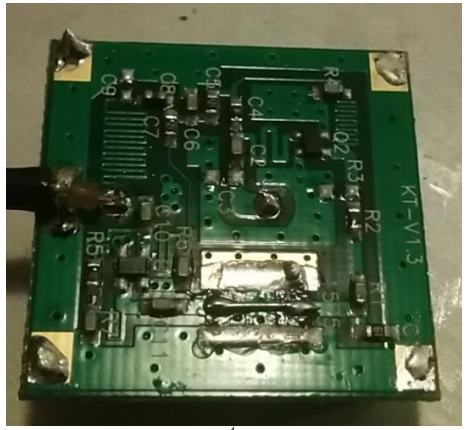
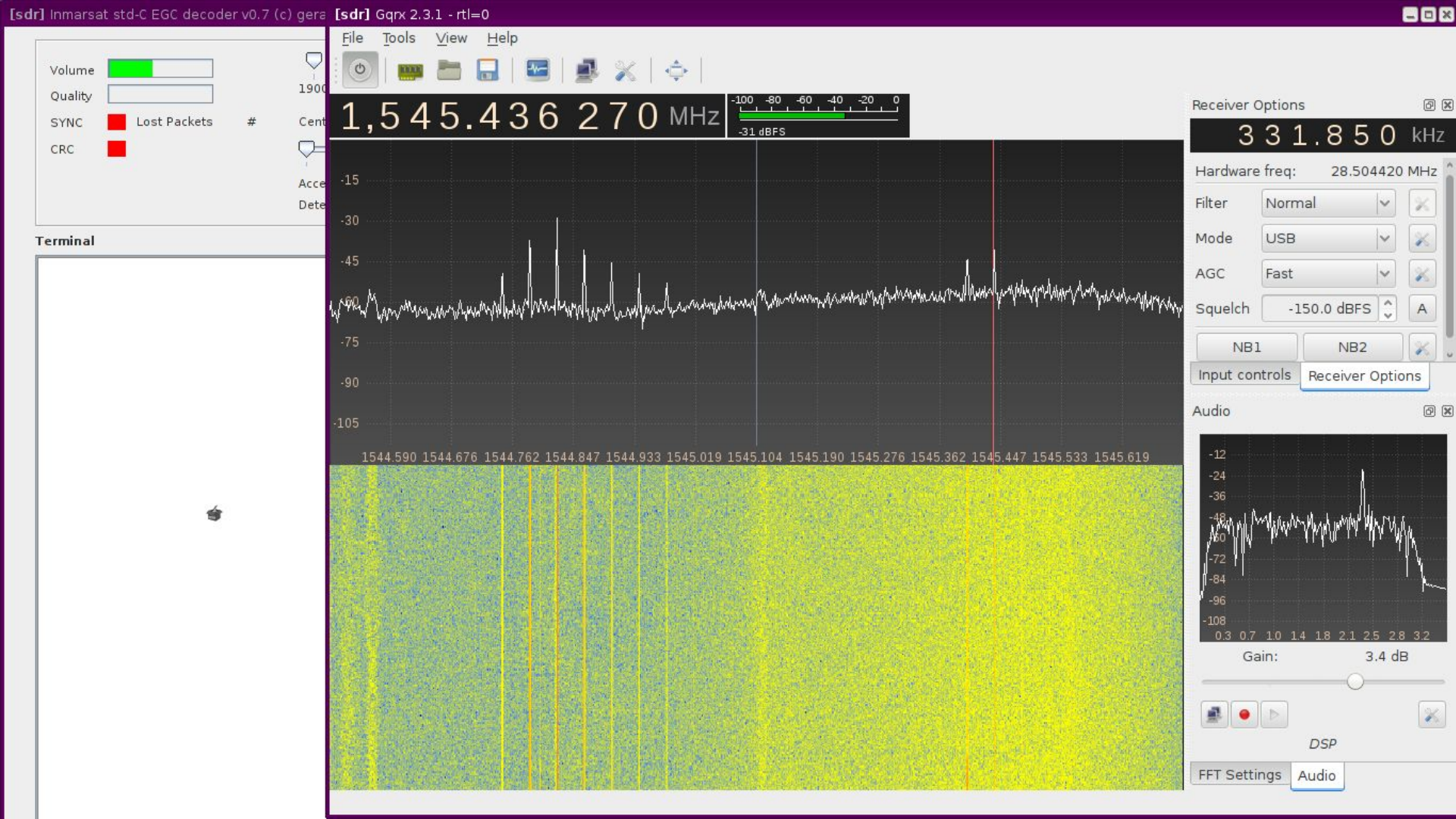
https://www.youtube.com/watch?v=mqJ9zBzCebk - https://events.ccc.de/congress/2015/Fahrplan/events/7154.

GPS Antenna Mod





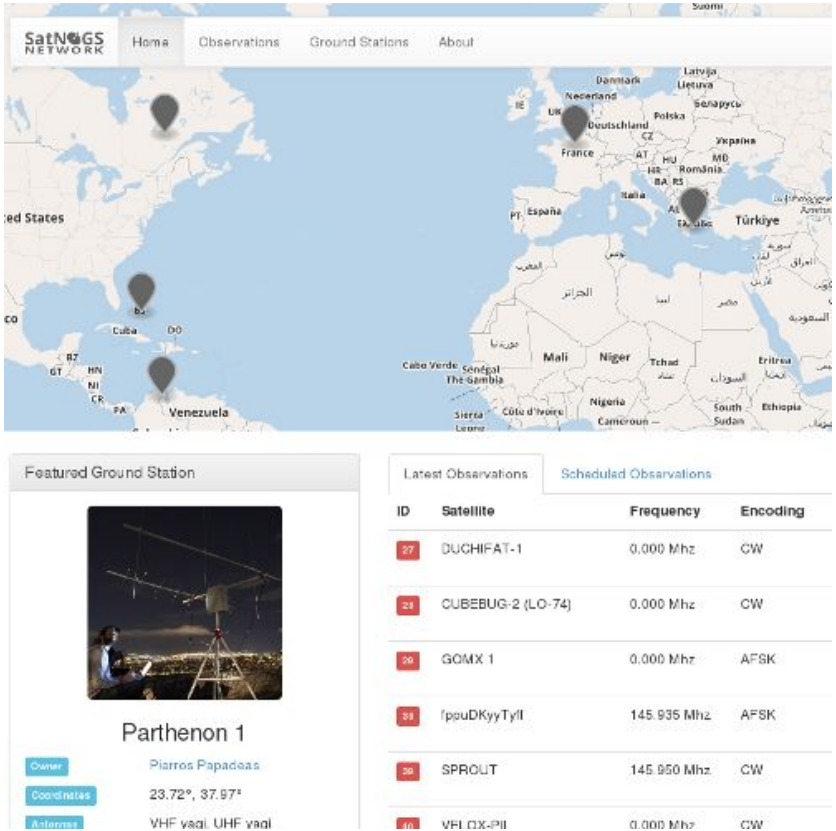



[sdr] Inmarsat std-C EGC decoder v0.7 (c) gera
[sdr] Gqrx 2.3.1 - rtl=0
Volume
Quality
SYNC
Lost Packets
#
CRC
Terminal
File
Tools
View
Help
1,545.436 270 MHz
-100 -80 -60 -40 -20 0
-31 dBFS
-15
-30
-45
-75
-90
-105
1544.590 1544.676 1544.762 1544.847 1544.933 1545.019 1545.104 1545.190 1545.276 1545.362 1545.447 1545.533 1545.619
Receiver Options
331.850 kHz
Hardware freq: 28.504420 MHz
Filter Normal
Mode USB
AGC Fast
Squelch -150.0 dBFS
A
NB1
NB2
Input controls
Receiver Options
Audio
-12
-24
-36
-48
-60
-72
-84
-96
-108
0.3 0.7 1.0 1.4 1.8 2.1 2.5 2.8 3.2
Gain: 3.4 dB
DSP
FFT Settings
Audio

SatNOGS! - https://satnogs.org/

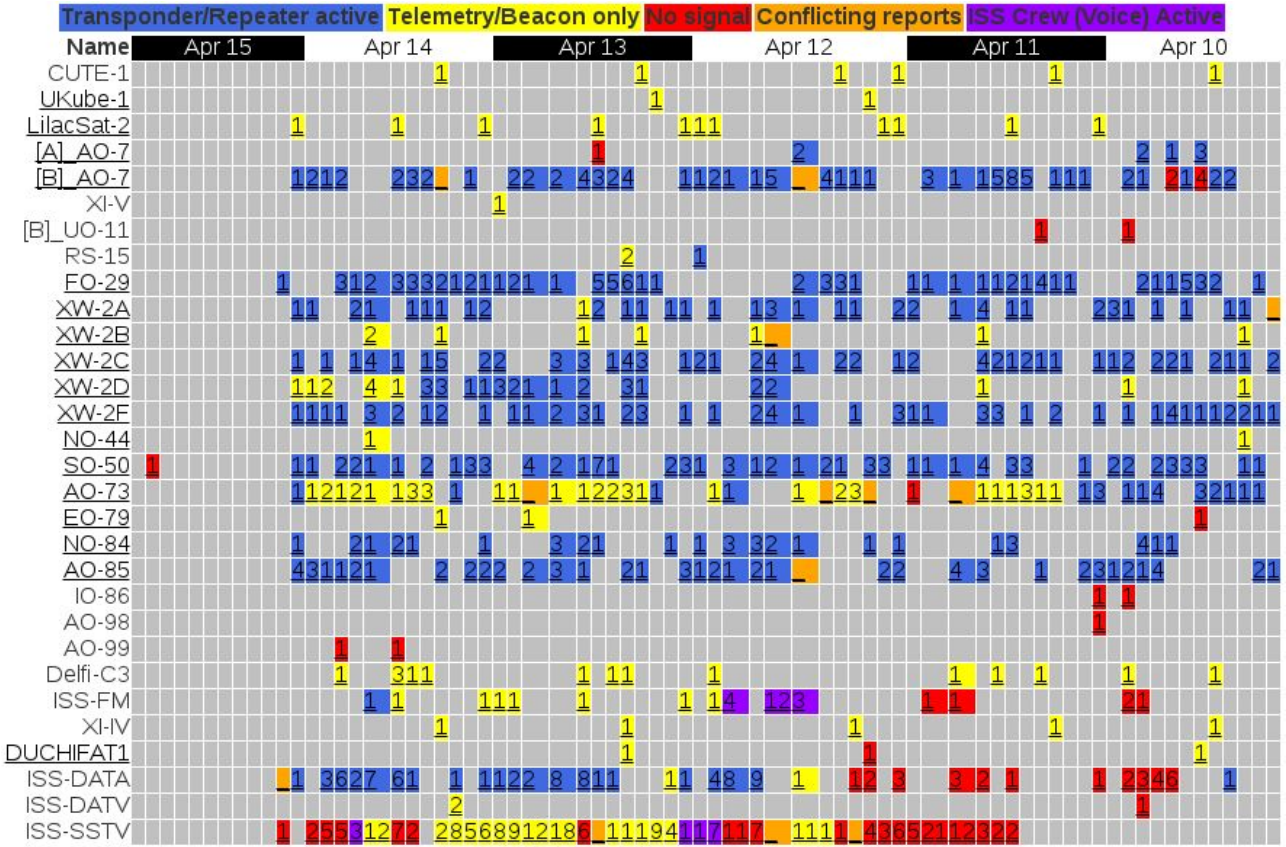
https://satnogs.org/documentation/hardware/

SatNOGS network



https://satnogs.org/

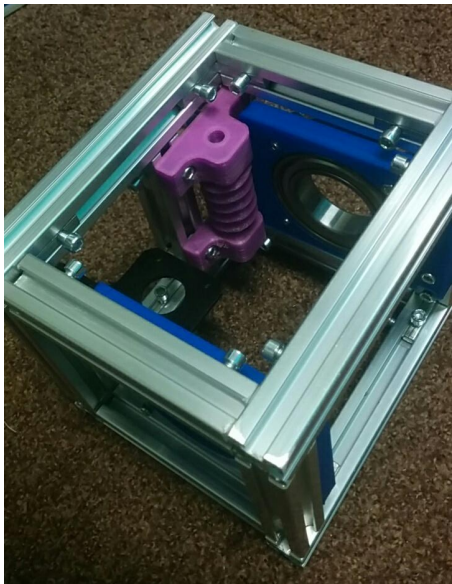
Amateur Satellites



http://amsat.org/status/

Hackerspaces are awesome

- 3D Prints from Monika, Paul.B, Max, Ian, Iggy, Steve
- Mechanical assembly from Declan, Joseph
- Testing adventures with Adam, Jamie, Ian, Paul.B, Declan, Max

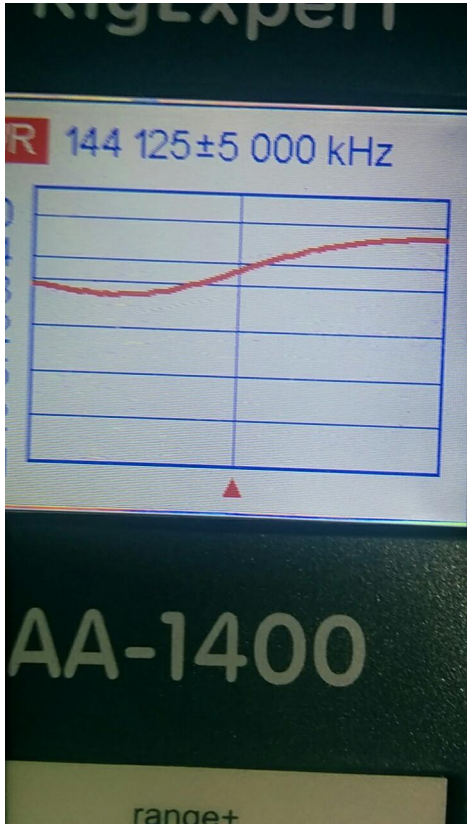


make. hack. void
A Canberra Hackerspace

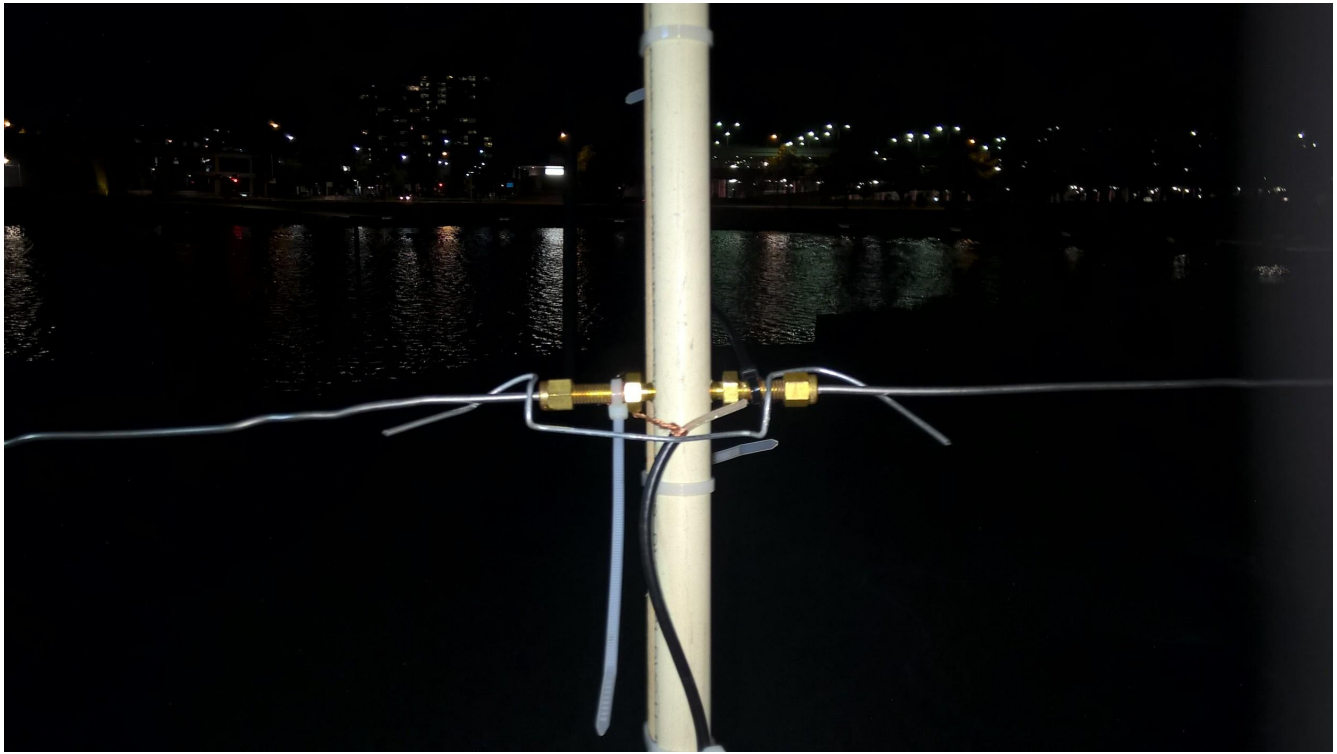
Testing adventures

Junk yard wars VHF Yagi

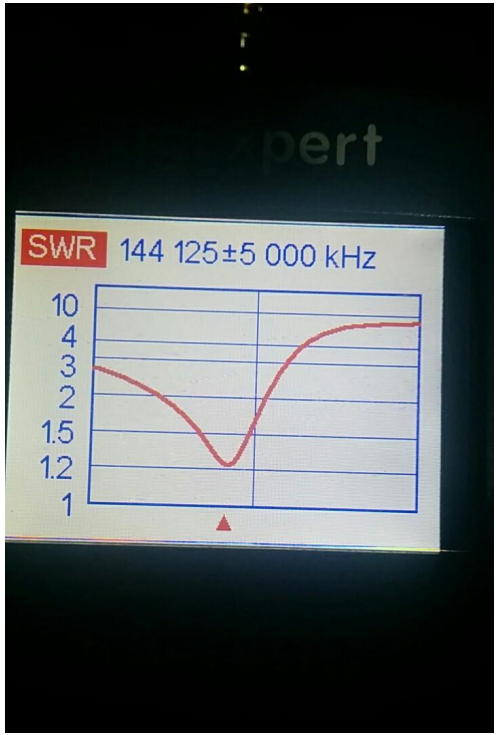
But we haven’t attempted any impedance matching!



Enter the “Buckley Match”



All better!



(confirmed gain & directionality with a pair of amateur radios)