

Having Fun with Your SDR Dongle



Learning about SDR the fun and cheap way



CMARA Meeting
04/20/14
W1BNC

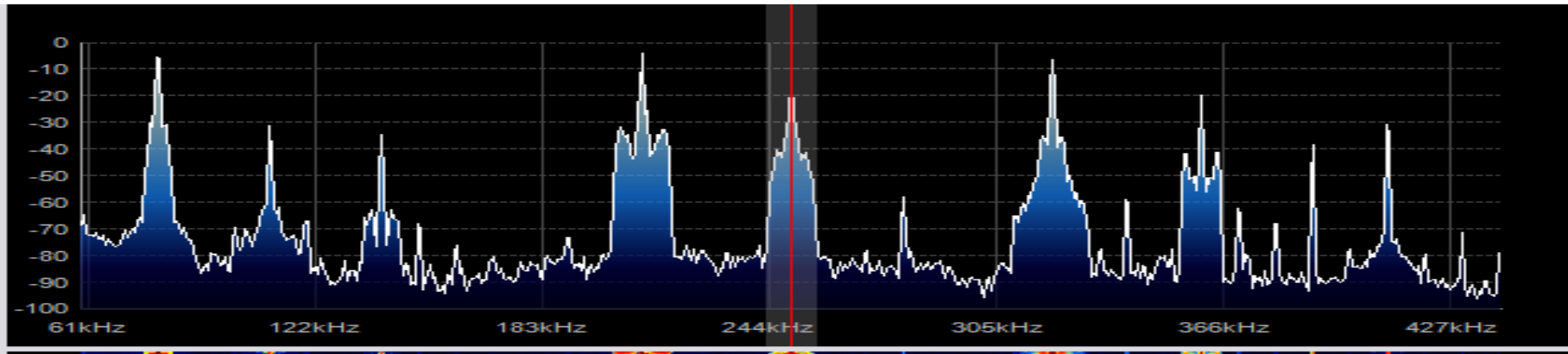
I wanted to learn about SDR, “hands on” and do it cheap

- ▶ This EBay bargain started it all
- ▶ Hardware
 - \$15 Tuner Stick (Dongle)
 - Laptop
- ▶ Just add:
 - ▶ Free SDR Software
 - ▶ Time and patience



Results: Hear, see and record

24 MHz to 1.86 GHz



▶ Ham Bands

- 17, 10, 6, 2 meters
- 220, 432, 902 and 1296 MHz

▶ DeModulate

- AM, FM, LSB, USB, CW
- *DV**, *AP25*, *Tetra*
- *DMR*, *Mototurbo*

▶ FM Broadcast

- ▶ Digital Radio Mondial*

▶ Public Service

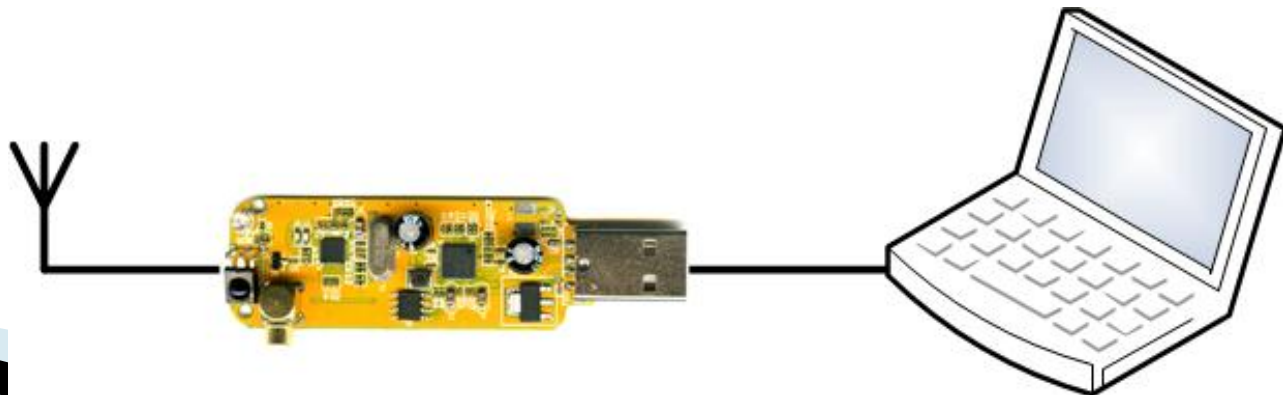
- ▶ Aircraft Band (AM)
- ADSB 1090 MHz mapping
- NWS Weather

▶ Spacecraft Data

- Mars mission
- NOAA Wx
- Inmarsat
- Voyager

What is an SDR Radio?

- ▶ To me:
 - ▶ A radio where you add significant features with software instead of solder
- Simplest form (theoretical)
 - A computer with antenna jack, audio, an antenna and Signal decoding software
- (Real World) No antenna jack on generic PC
 - Need to convert RF from antenna into data the software can decode



What is a Dongle?

- ▶ Slang for a hardware key necessary to authorize protected software
- ▶ Origin sometimes attributed to:
 - Rainbow Technologies
 - *1992 Byte Magazine*, their ad copy claimed that "dongle" was a derivation of its inventor, a Mr. "Don Gall."
 - Myth persisted
 - 1996 Third Edition of *The New Hacker's Dictionary*, put it like so: "The company's receptionist will cheerfully tell you that the story is a myth invented for the ad copy"



Origin:

Converting a PC into an HDTV

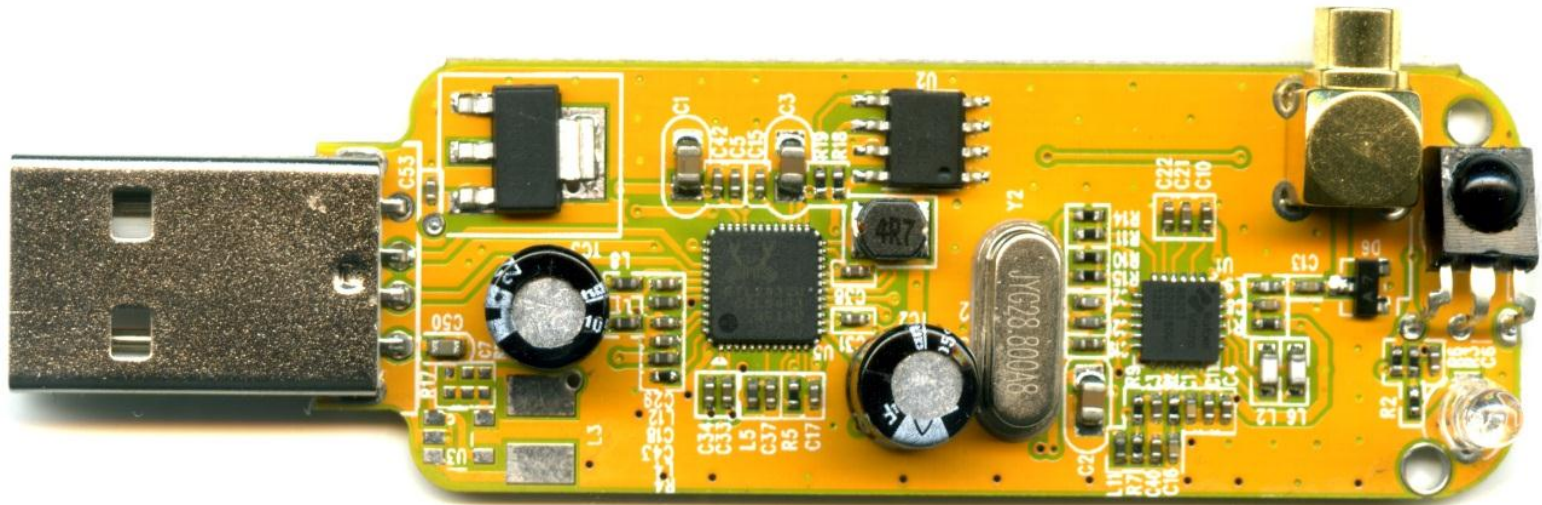
- ▶ PC Card
- ▶ Cigarette Pack
- ▶ USB SDR (Dongle)



What's inside the RTLSDR Dongle?

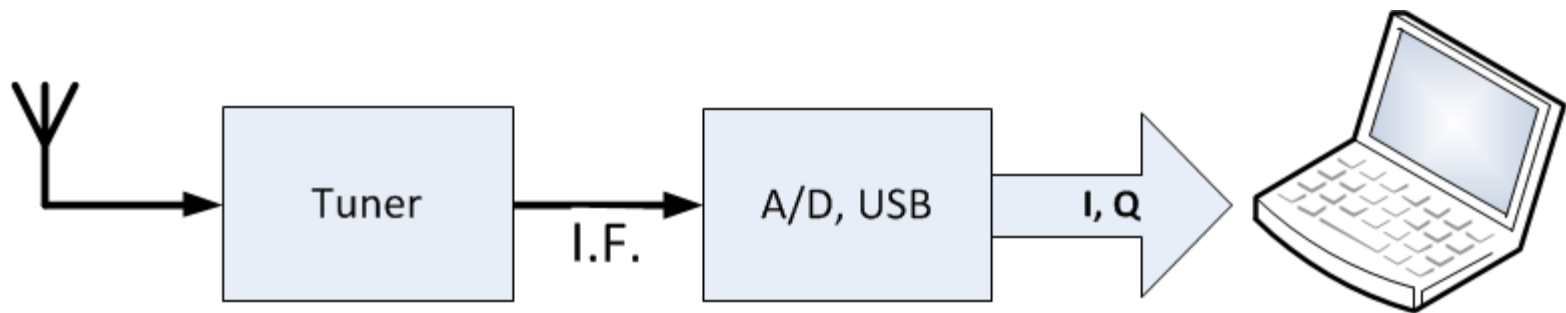
Two Major ICs

- ▶ Tuner: Rafael Micro R820T
- ▶ I/Q Demod, A/D, USB Realtek RTL2382U



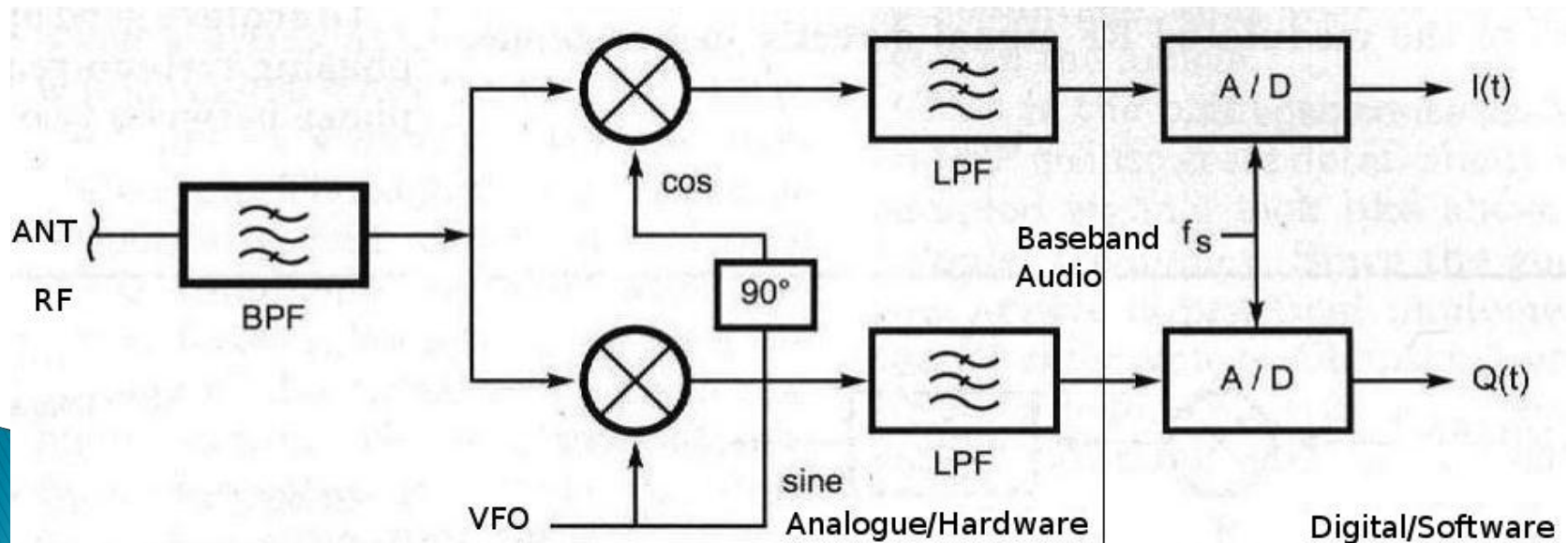
What makes this dongle so powerful for Ham Radio?

- ▶ Very Cool Hack makes it talk to Free SDR Programs
 - ▶ RTL2832U has some undocumented commands/registers, by which it can be placed into a mode where it simply forwards the unprocessed raw baseband samples (up to 2.8 MS/s 8-bit I+Q) via high-speed USB into the PC,

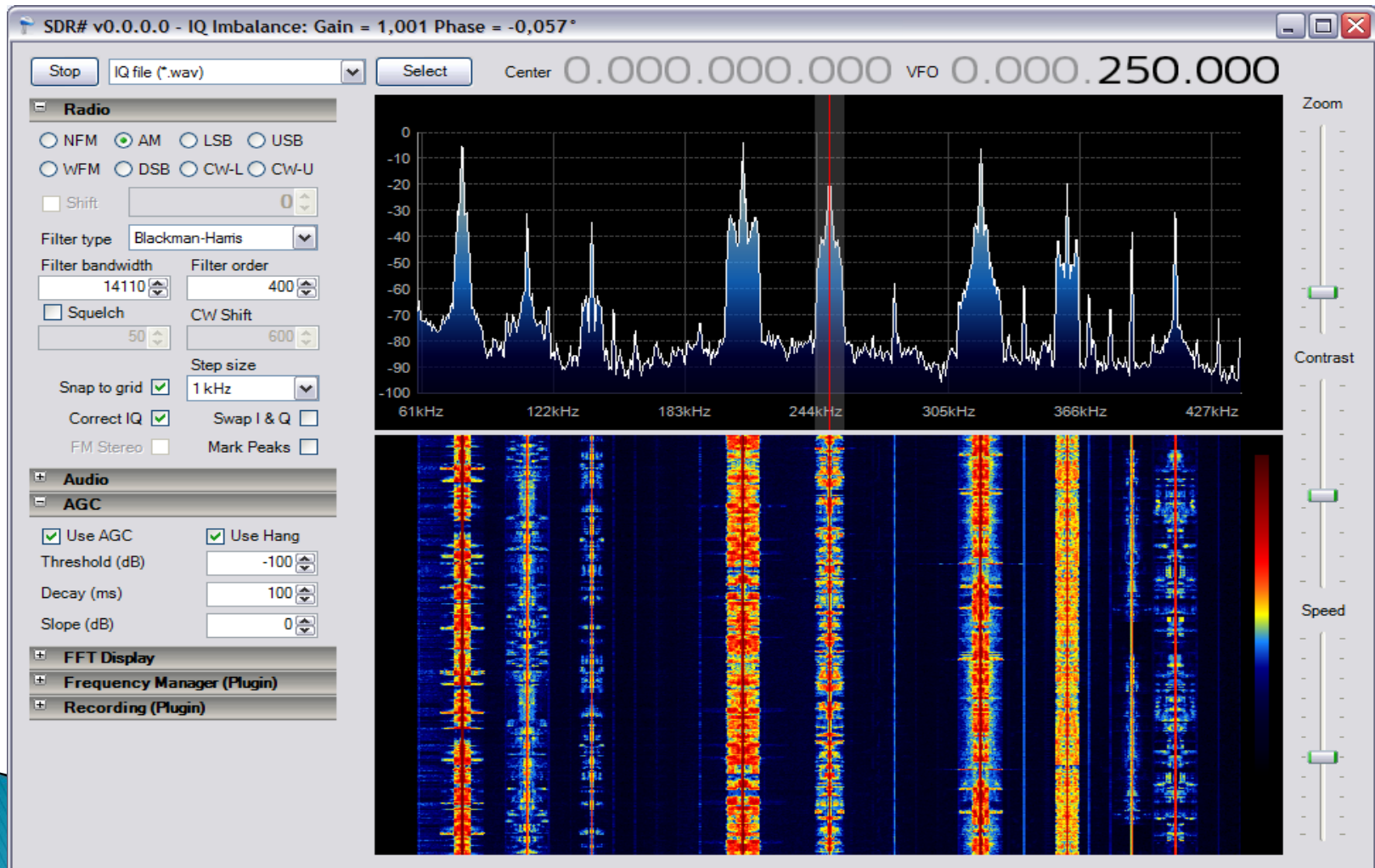


How do they do it?

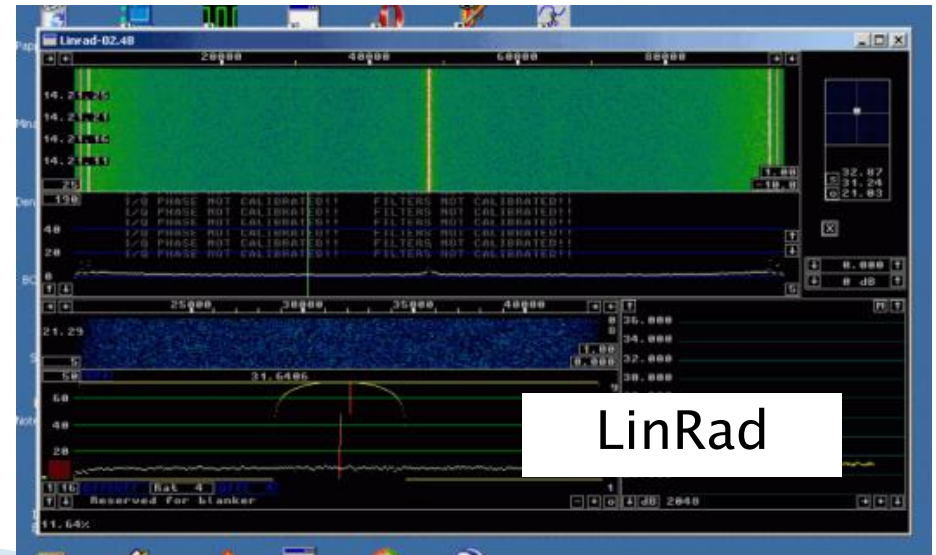
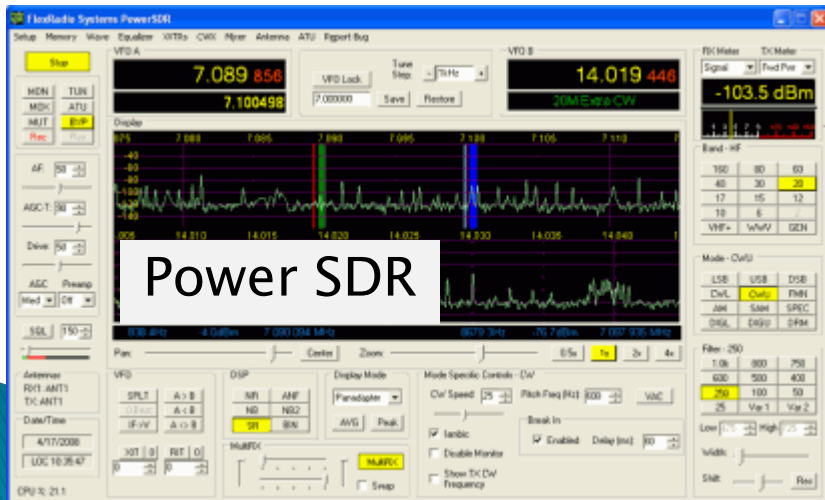
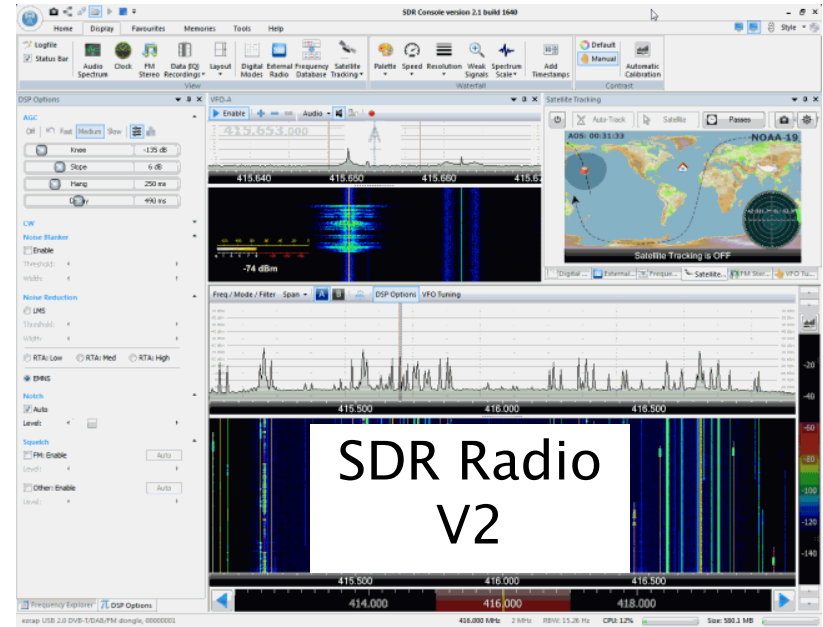
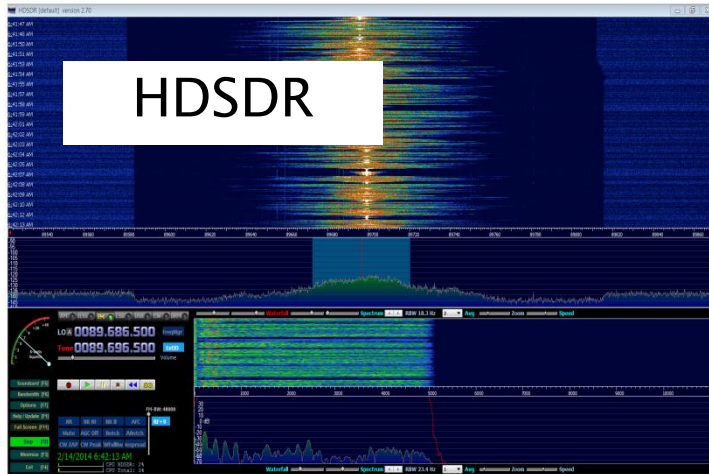
- Goal:
 - Convert RF from antenna into Data the software can decode into sound
- 3 steps
 - Convert antenna RF down to baseband with DDS/mixers
 - Create DSP friendly I and Q versions
 - Digitize each pass to USB interface



- SDR software runs I and Q data thru equations
 - to demodulate almost anything
 - Creates Spectrum Display, Waterfall,
 - Filter with DSP....




SDR Software Packages: Win, OsX, Linux



Plug ins!

LevelMeter (Plugin)

Peak Power VFO



-25 dB

Mode: Peak Power VFO

Smoothing: [Slider]

Peak Power VFO [dB]: -17

Avg Power BW [dB]: -42

Peak Power BW [dB]: -14

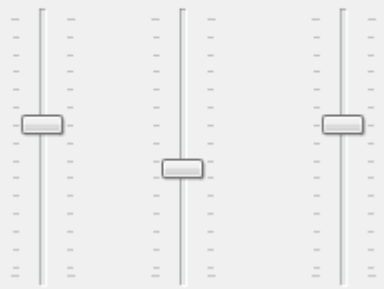
Simple Audio EQ (Plugin)

Audio Equalizer

Enable

Bass Boost

Low Mid High



CTCSS Decoder (Plugin)

Detect

Enable Tone detected

115.1 Hz 114.8 Hz

Squelch

Enable

Squelch tone: 111 Hz

Frequency Scanner (Plugin)

Scan: all with save new

Edit: Screen

Start: 0

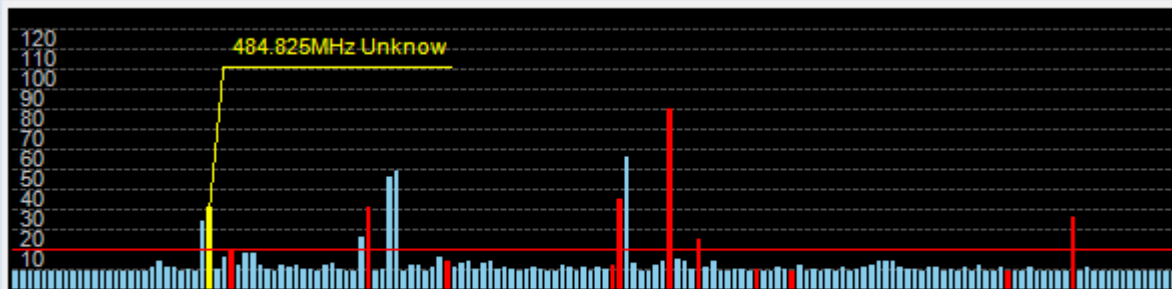
End: 0

Stop scan

Clear X Delete

Activity time	Frequency
648	485.025 MHz
1299	485.850 MHz
494	485.0875 MHz
624	485.1375 MHz
634	485.150 MHz
358	484.5625 MHz
494	484.575 MHz
459	484.8875 MHz
62	485.275 MHz
175	486.025 MHz
285	484.900 MHz
38	485.650 MHz

484.825MHz Unknow



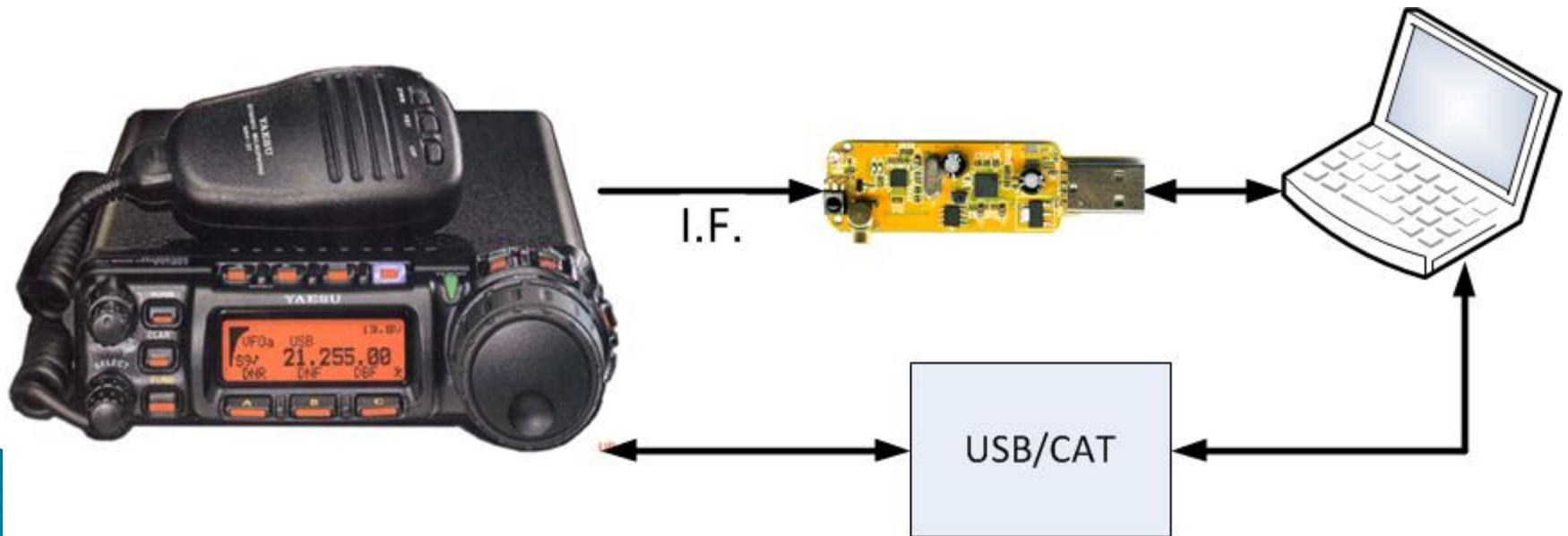
Level Squelch Next s Detect ms Volume

20 70 2 200

Pause Skip No skip

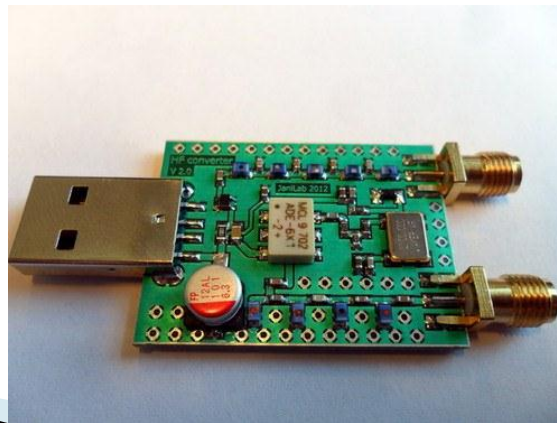
Panoramic Display

- ▶ Add an inexpensive “click and go” *Spectrum Display* to your rig (VHF–I.F.)
 - \$15 (Dongle)
 - Laptop
 - USB to RS-232 adaptor
 - SDR Software



Adding HF Coverage

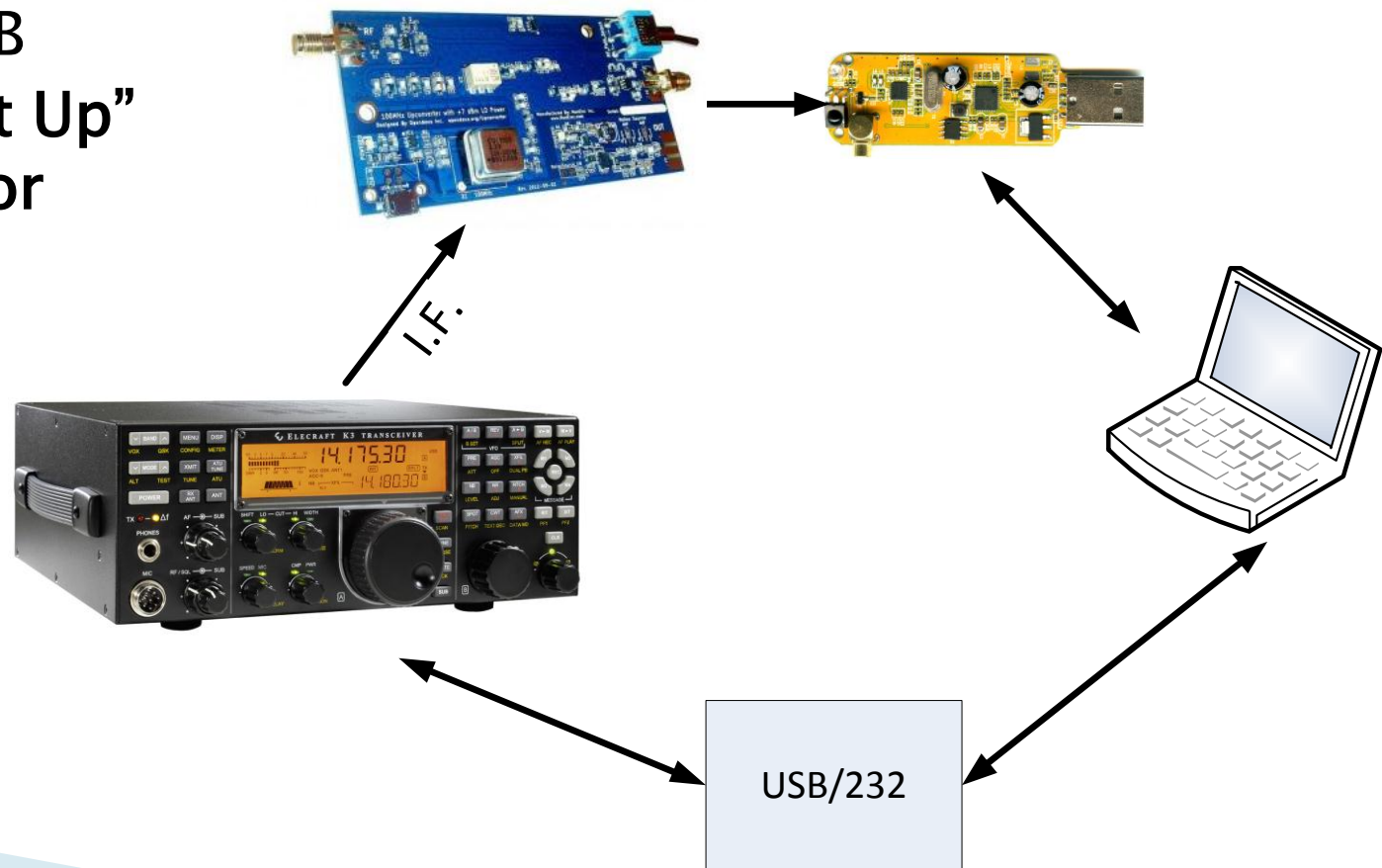
- ▶ \$45 Hardware fix
 - ▶ HF to VHF up convertor
 - Input
 - 0-30 MHz
 - Output
 - X 125 MHz L.O.
 - ▶ Several configurations
 - ▶ Standalone, USB, Internal



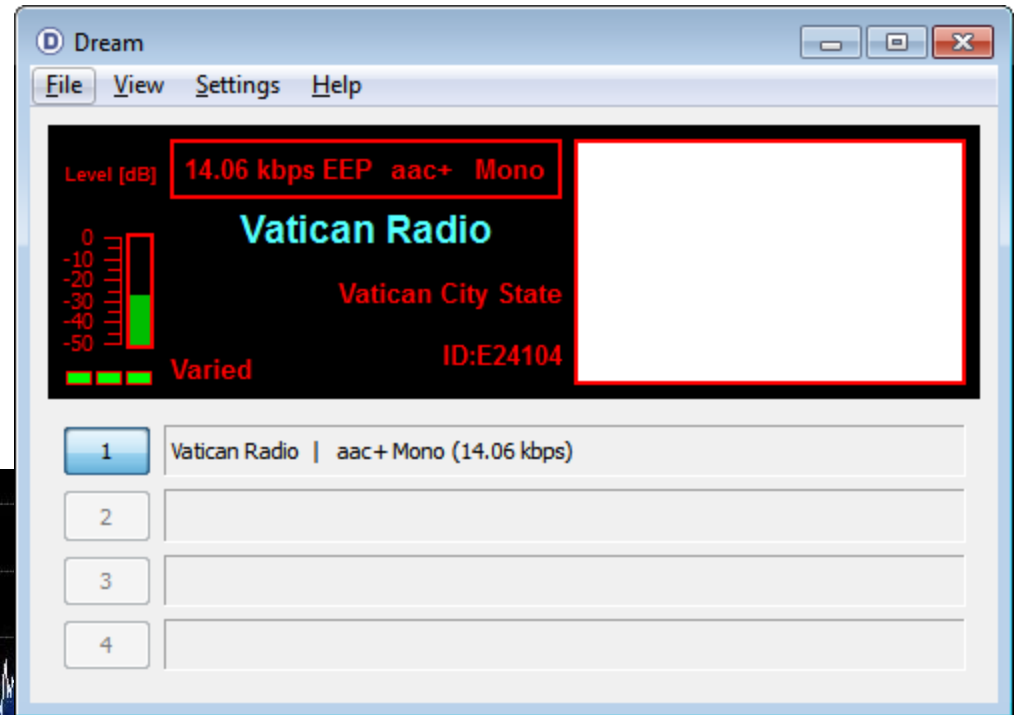
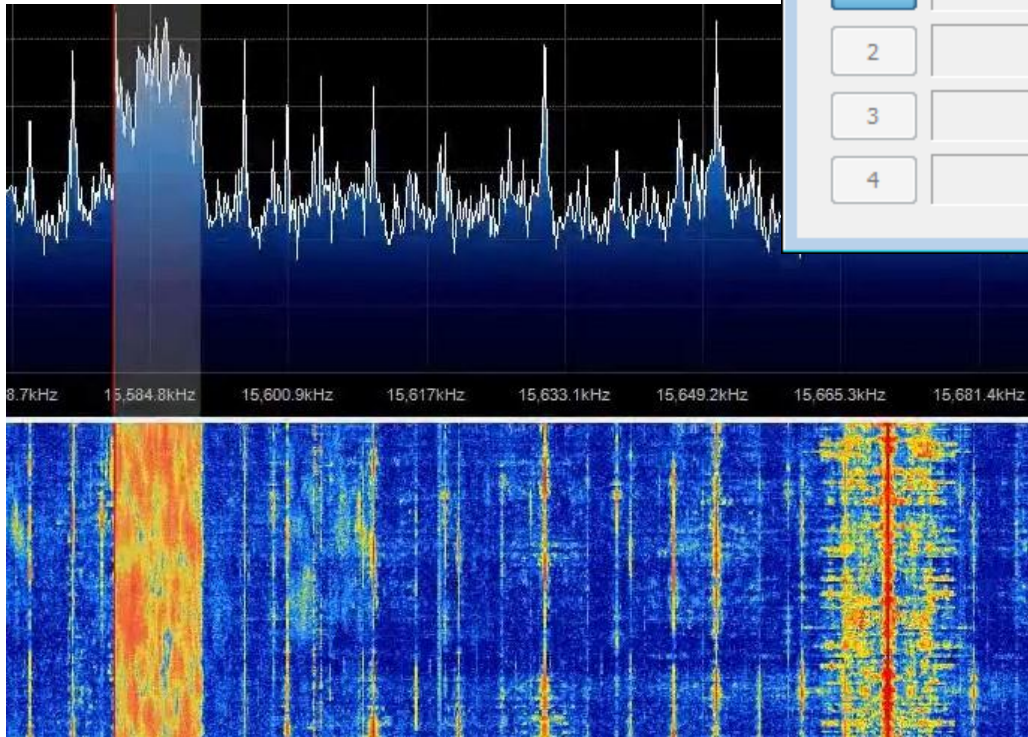
Panoramic Display (HF I.F.)

▶ Hardware

- \$15 (Dongle).
- RS-232/USB
- \$45 “Ham it Up”
Up convertor



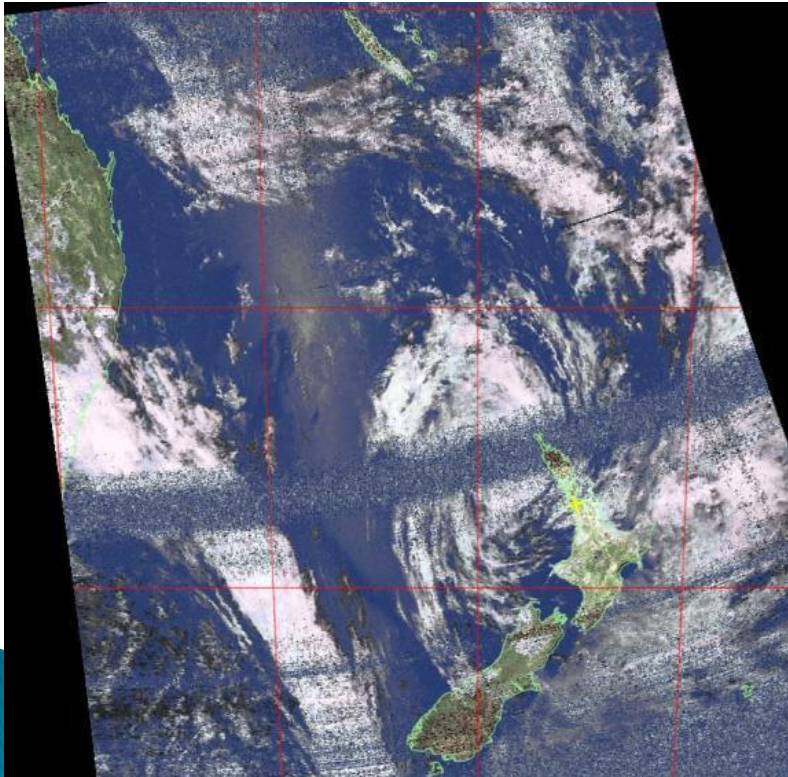
Non-Ham Apps: DRM Radio



- ▶ Digital Radio Mondial
- ▶ Dream Plug - In

Additional Applications:

NOAA WX



The screenshot shows the Orbitron 3.71 software interface. The main window displays a world map with satellite orbits and positions. The NOAA 19 satellite is highlighted with a green circle. The interface includes a list of satellites on the right, a control panel for NOAA 19, and a status bar at the bottom.

NOAA 19 [+]

Azimuth	283.3	Dnlink/MHz	145.000	Receive/doppler	144.997686	Dnlink mode	FM-W	Driver	SDRSharp
Elevation	-11.7	Uplink/MHz	145.000	Transmit/doppler	145.002314	Uplink mode		Object	Satellite

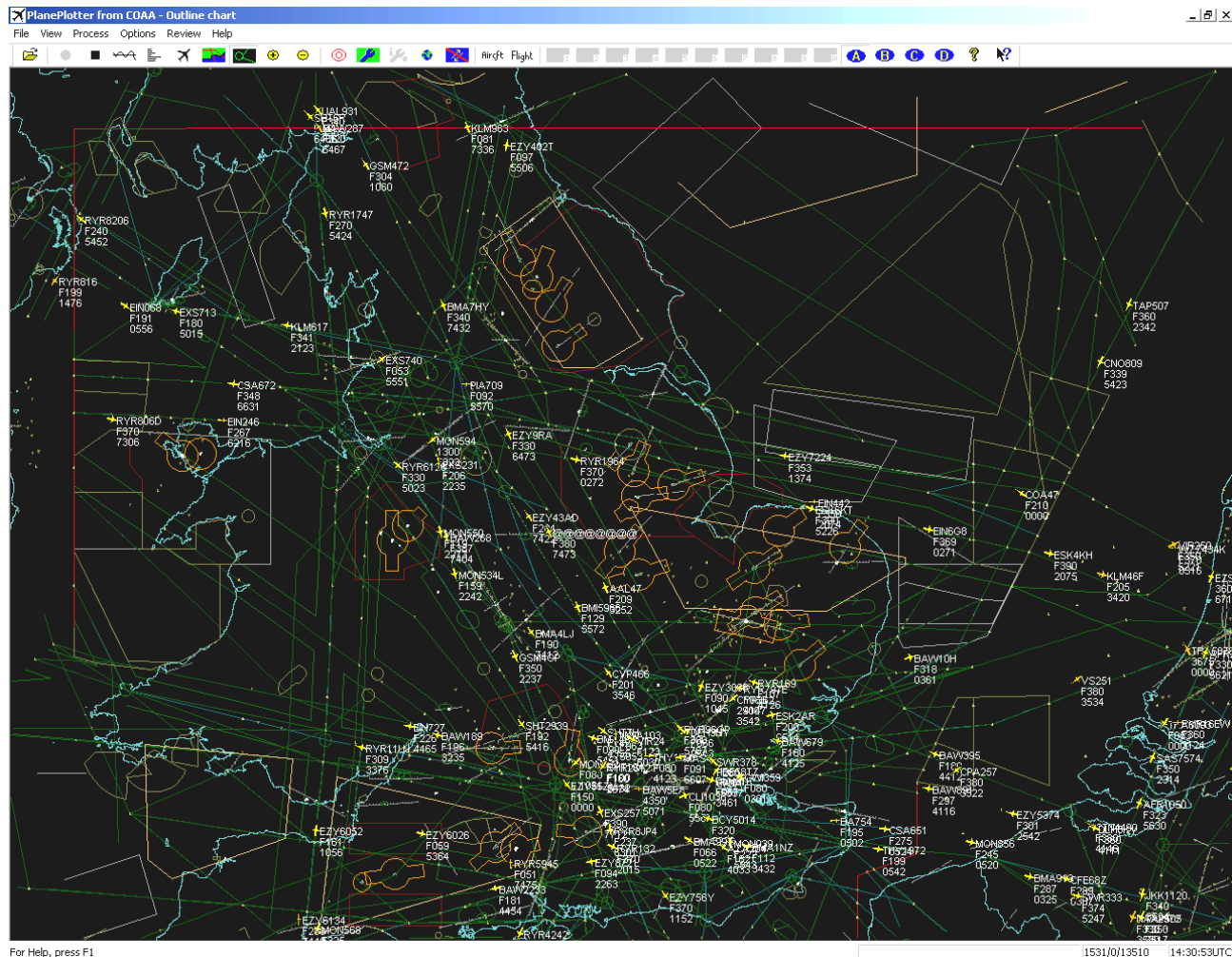
DDE conversation with driver is NOT active

Orbitron 3.71 - (C) 2001-2005 by Sebastian Stoff

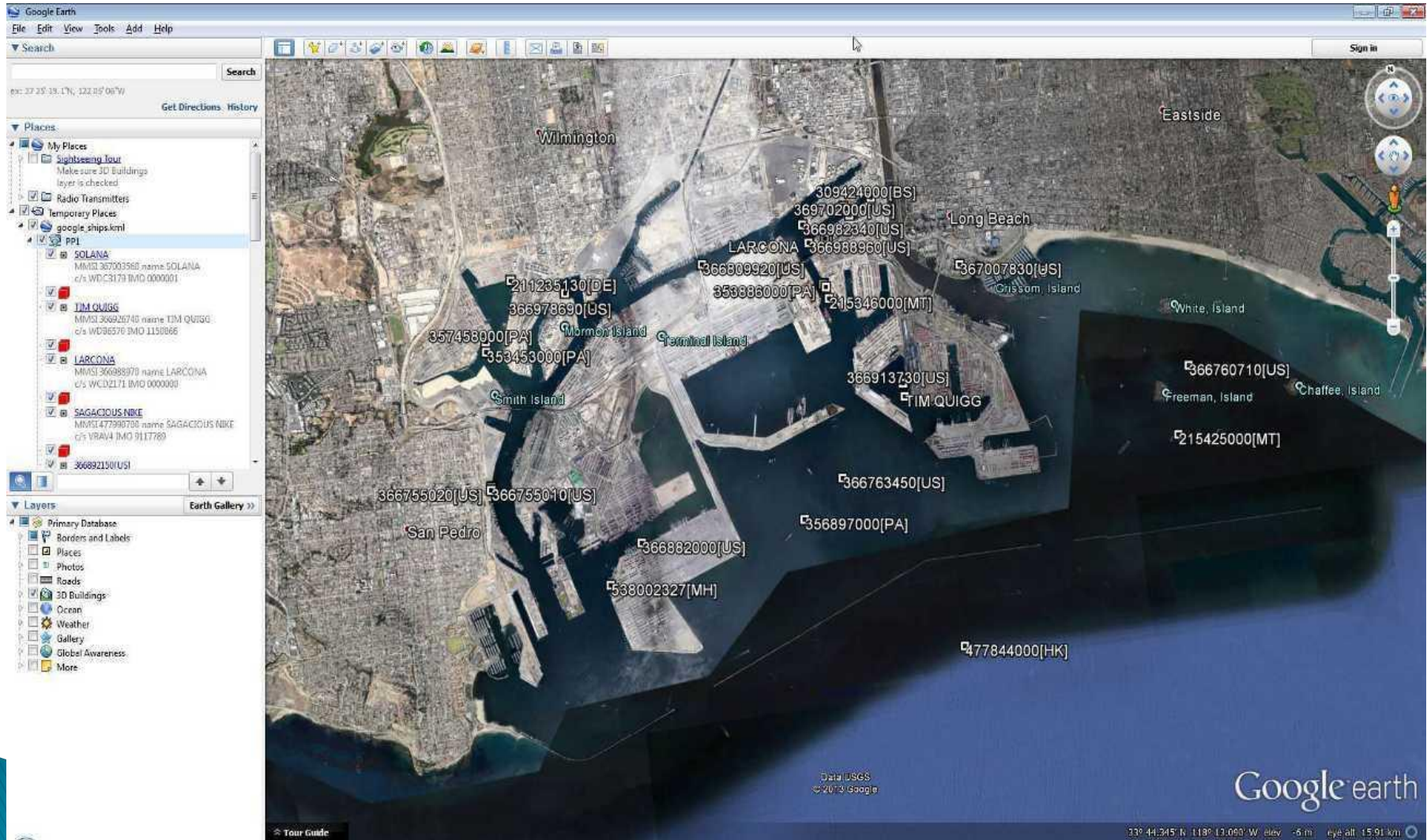
- Receives Wx Pix and plots Satt position

ADSB 1090 MHz Fight Mapper “Virtual Radar”

- ▶ GPS data sent from commercial aircraft
- ▶ See QST Article
- ▶ Collinear homebrew antenna
- ▶ Plane Plotter
- ▶ Flight Trader



AIS Ship Tracking



Warning about Adaptors

Problem:

Fragile MCX connectors used on Dongle can be easily damaged!!!!!!

Recommend pigtail over hard adaptor

Guess why I say that....



What's Next?

- ▶ Higher performance
 - Transmit Dongles?
 - Transceiver Dongles?
- Genesis
- Apache Labs
- Hack RF
- HamSDR
- More and more...



Questions ??

Have fun with your...

Thank You

Disclaimer:

*Unsafe for use by hardcore appliance operators or those
without a sense of humor*