

Note: We will be recording all Bootcamp Sessions. Anyone not wishing to be recorded should mute their video or disconnect.



GETTING STARTED WITH AMATEUR RADIO SATELLITES

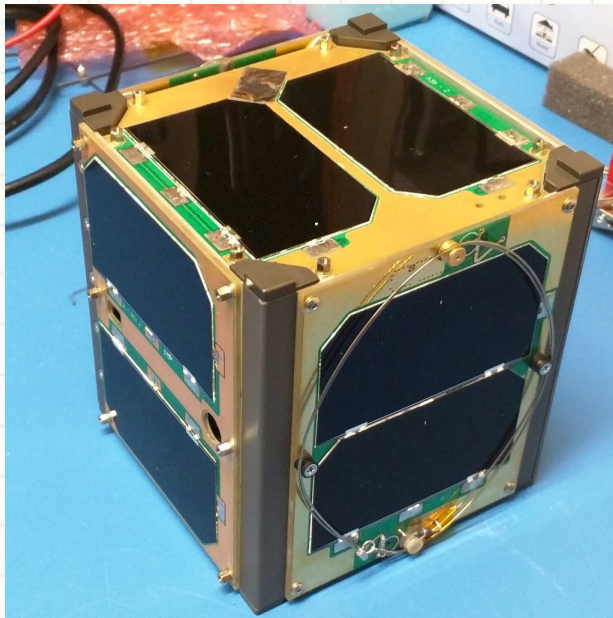
Nashua Area Radio Society

Fall 2020

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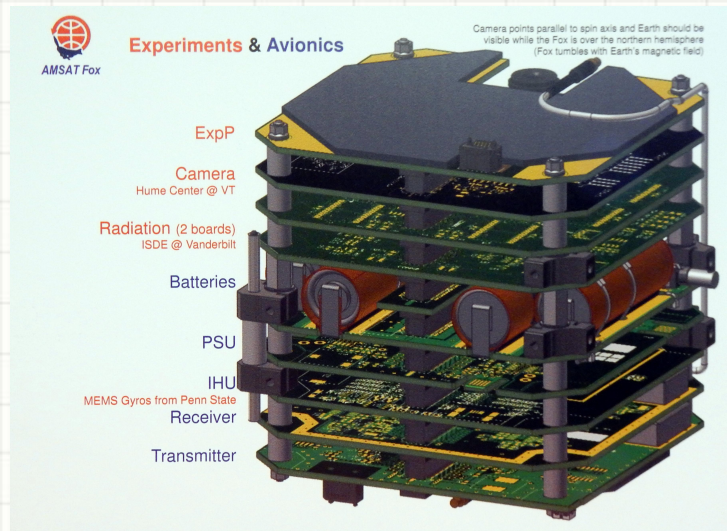
Amateur Satellites

- Orbiting Satellites Carrying Amateur Radio (OSCAR)
- They are small!
- They ride share with big payloads



Amateur Satellites

- Have amateur Rx and Tx
- Some have experiments
 - Helps to secure grants to pay for our satellites!
- Costs nothing to use



Experiment Boards

Receiver & Transmitter

What Can I Do With Amateur Satellites?

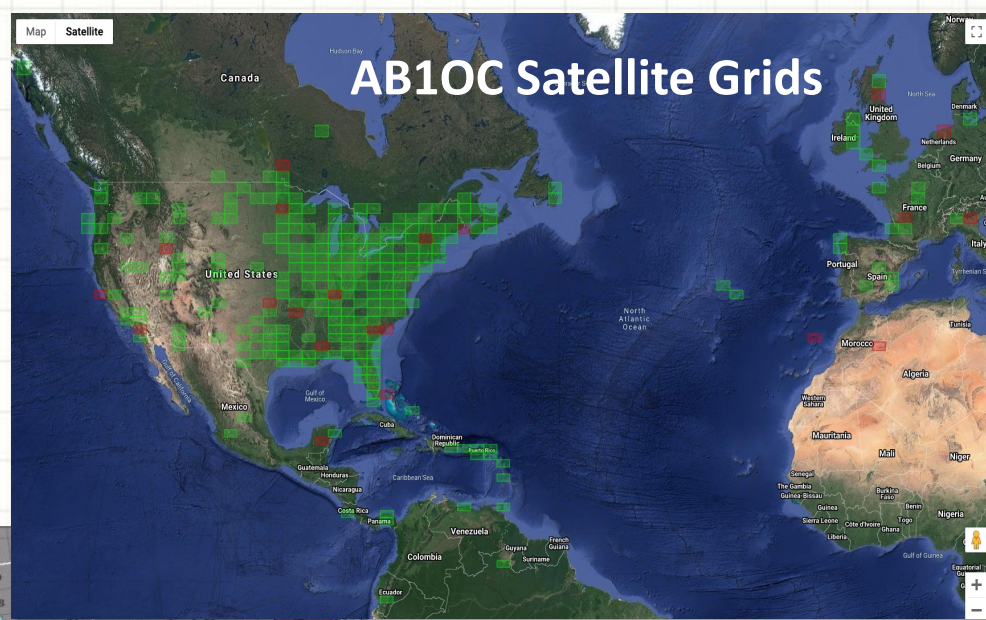


- Learn New Skills/Ideas
- Collect Data/Messages/Pictures (think Short Wave Listener)
- Communication ← What we will mainly talk about
 - With other other hams (+ astronauts in space)
 - Contesting
 - Extra points on field day
 - Satellite-specific awards
 - Improve weak signal skills

Where Am I Located?

Maidenhead Grid Squares

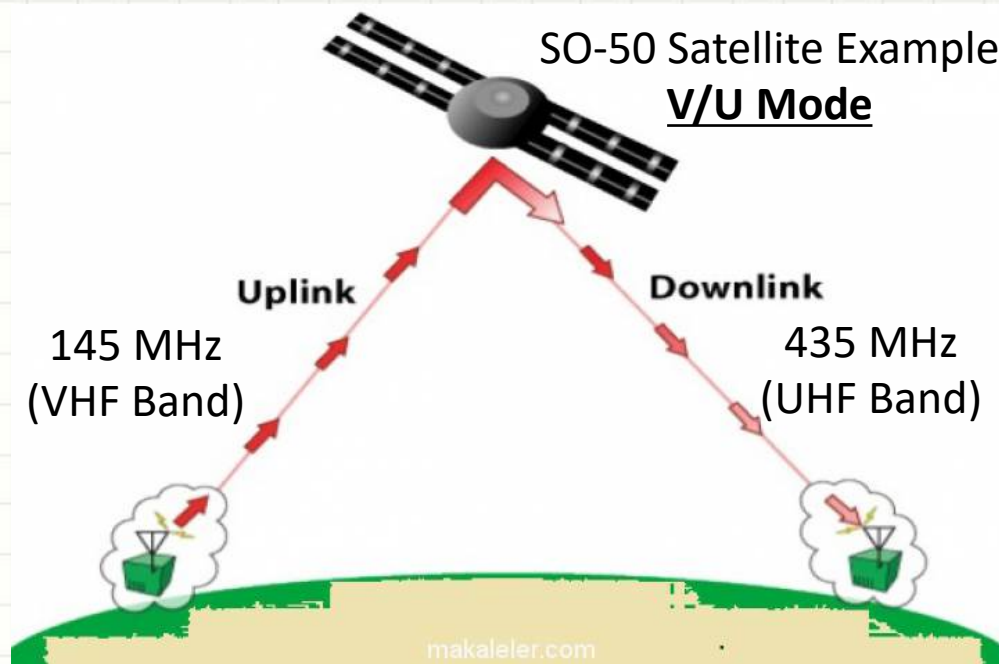
- Maidenhead Grid Squares divide up the world into a combination of 2 letters + 2 digits
- Each grid is approx. 70 miles X 100 miles



- Hams try to work a station in every grid square
- Earn a VUCC Award for confirming 100+ grids

Things to Consider

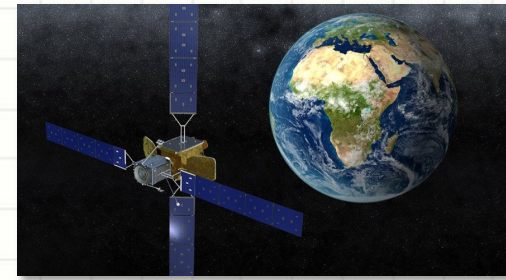
Uplink and Downlink Bands



- Unlike terrestrial repeaters where Tx and Rx are in same band
- We send our signal to a satellite on the uplink and we receive other users' signals on the downlink
- Satellites use different frequencies and bands to receive our signals and return them to earth
- Its important to be able to hear your own signal in the downlink – use two radios to enable this

Things to Consider

Satellite Tracking

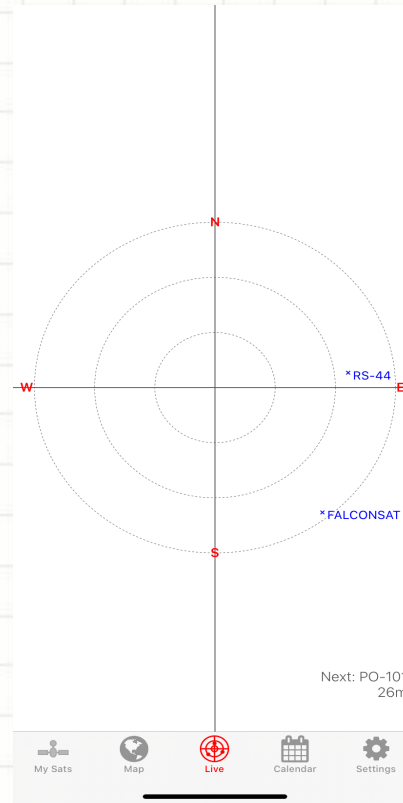


- Satellites are moving around the world
 - In view about 10 min (a pass)
 - 2-6 passes per day
 - All at different angles and directions
- Apps tell when and where satellite is
- Many apps on IOS, Android, PCs

2:42 1

Passes

| | |
|-----------------|-----|
| FALCONSAT-3 | 11° |
| LOS 2m | |
| RS-44 | 25° |
| LOS 10m | |
| PO-101 | 46° |
| Fri 30 15:09:16 | |
| FO-29 | 11° |
| Fri 30 15:14:09 | |
| AO-07 | 90° |
| Fri 30 15:27:32 | |
| AO-27 | 6° |
| Fri 30 15:59:18 | |
| FALCONSAT-3 | 6° |
| Fri 30 16:13:24 | |
| RS-44 | 72° |
| Fri 30 16:24:24 | |
| AO-73 | 31° |
| Fri 30 16:38:36 | |
| XW-2C | |

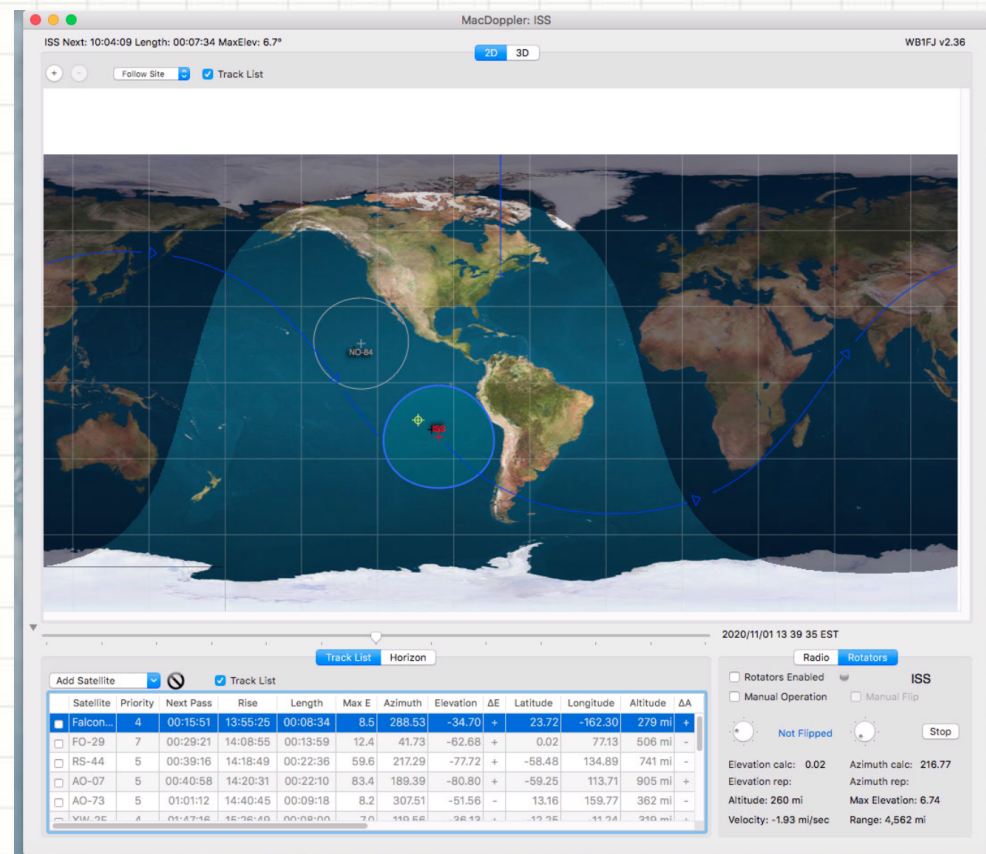


IOS App Example: Satsat

Satellite Tracking

Other Apps

- **Android:** AmsatDroid
- **Mac:** MacDoppler (\$)
- **Windows:** SatPC32 (\$)
- **Linux:** Gpredict (Free)



How do the apps know where satellites are?

- Keplerian Elements downloaded from internet

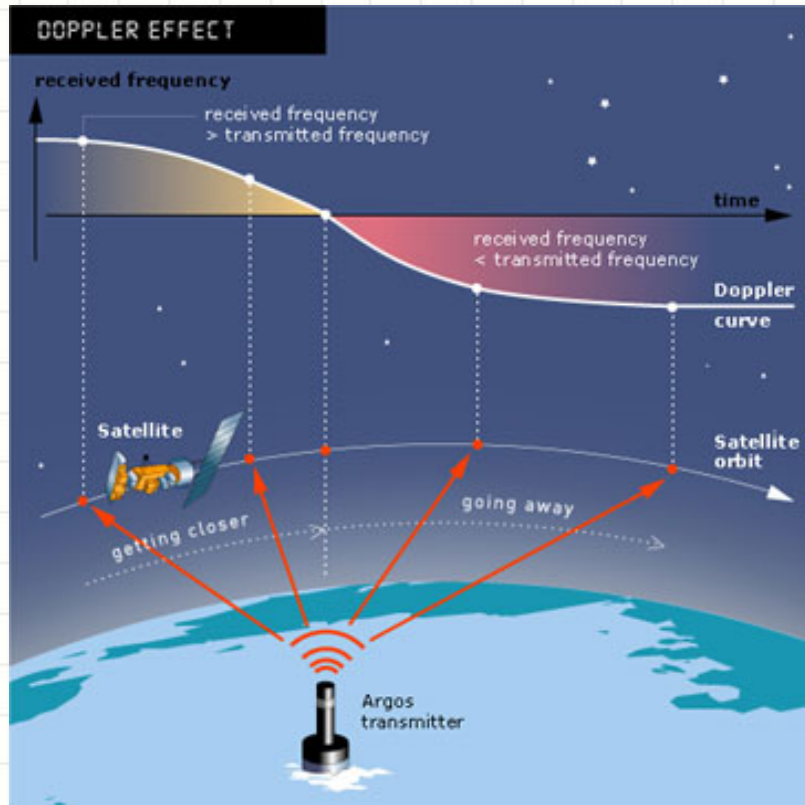
This set of numbers is all you need to track each bird:

SO-50 1 27607U 02058C 20303.41730594 .00000041 00000-0 26214-4 0 9992 2 27607 064.5555
324.7826 0032786 129.0565 231.3463 14.75671885960481

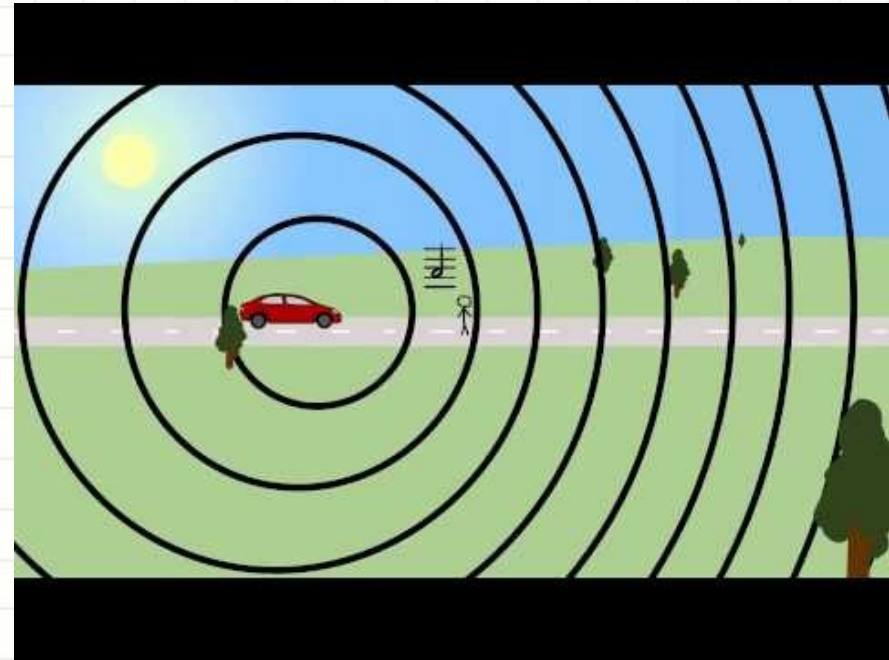
Things to Consider

Doppler Shift

[Video on YouTube](#)



Radio waves sent from fast moving objects also experience Doppler Shift



- LEO Satellites and the ISS are in low orbits and must move at high speeds
 - Typical orbital velocity \approx 17,500 mph or nearly 5 miles/sec

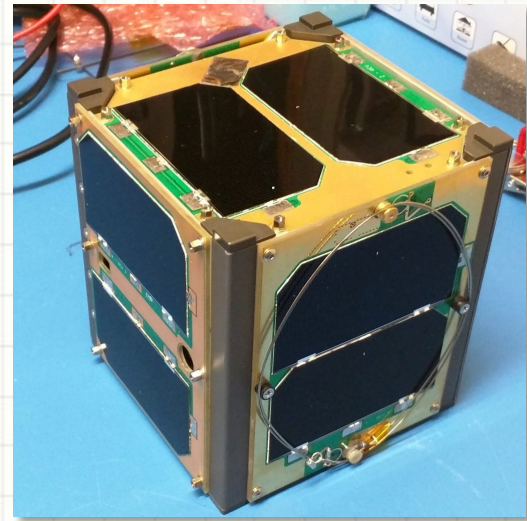


A Satellite Ground Station must adjust its transmit (uplink) and receive (downlink) radio frequencies to compensate for Doppler Shift.

Types of Satellites

FM EasySats, Linear Sats, Digital Sats...

- FM Repeaters
 - “EasySats” but they are very busy!
 - **That’s mostly what we will talk about**
- Telemetry only
- Linear Transponders
 - Harder to work but more users possible
 - Usually use sideband (USB/LSB)
 - Best done with computer control
- APRS (digital packet)
- Other kinds of digital



Getting Started

What Equipment Do I Need?

Requirements:

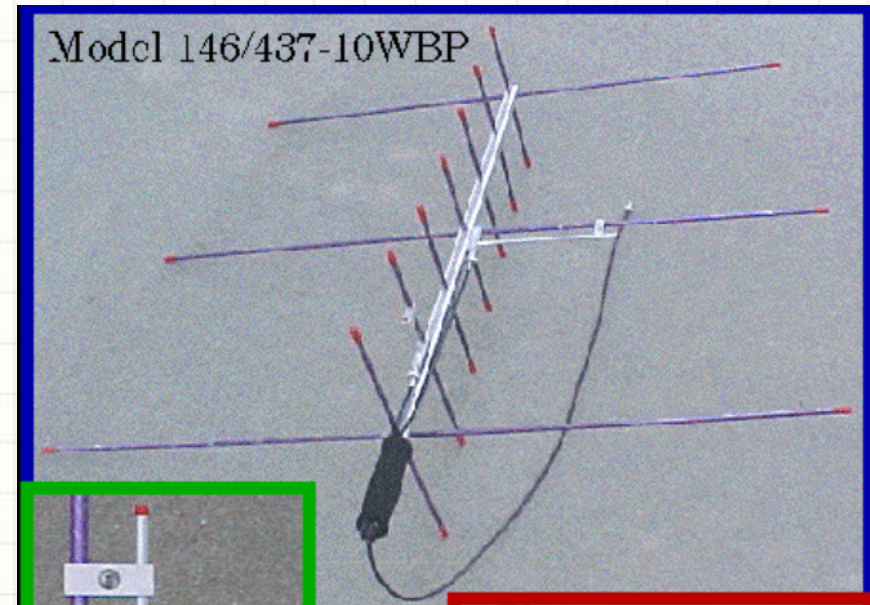
- Frequencies
 - Antenna and Radio must be able to deal with both uplink and downlink bands simultaneously
- Motion
 - Must track satellite as it moves
- Technique
 - Listen for YOURSELF on the downlink while transmitting on uplink
- Antenna Gain
 - Satellites are low power, as are HTs. Antenna gain is required.



Getting Started

Antennas (handheld)

- Handheld yagis are the most common
- Arrow Yagi Antenna
 - Notice separate 2 m elements and 70 cm elements
 - Two Yagi antennas on one boom.
 - Two feedlines, one for each band
 - Must rotate to align with satellite polarity for Rx and Tx
- Tripod or some sort of support can be helpful



This Arrow can have an optional diplexer in handle for single feedline

Radios for Satellites

Two Inexpensive HTs

- For example Baofeng BF-F8HP (many others)
- \$70^{ish} on Amazon - many others are cheaper
- Good choice with an Arrow antenna which has two feedlines - one for each radio
- A Headset with a PTT button will make operating much easier
 - Especially for hearing your own signal in the downlink
- Don't forget cables and adapters!
- Good for FM Only



Full Duplex Radio Antenna Options
Exist but are more \$

Getting Started

Programming Your HT(s) For Satellites

| AO-91 (U/V Mode) | Downlink (V) | Uplink (U) |
|-----------------------|--------------|----------------------------|
| Acquisition of Signal | 145.960 MHz | 435.240 MHz + 67.0 Hz Tone |
| Early in Pass | | 435.245 MHz + 67.0 Hz Tone |
| Mid Pass (TCA) | | 435.250 MHz + 67.0 Hz Tone |
| Late Pass | | 435.255 MHz + 67.0 Hz Tone |
| Loss of Signal | | 435.260 MHz + 67.0 Hz Tone |

| SO-50 (V/U Mode) | Downlink (U) | Uplink (V) |
|-----------------------|--------------|----------------------------|
| Activate SO-50 | --- | 145.850 MHz + 74.4 Hz Tone |
| Acquisition of Signal | 436.805 MHz | 145.850 MHz + 67.0 Hz Tone |
| Early in Pass | 436.800 MHz | |
| Mid Pass (TCA) | 436.795 MHz | |
| Late Pass | 436.790 MHz | |
| Loss of Signal | 436.785 MHz | |

Program HT(s) memories with frequencies for each FM satellite

Getting Started Summary

What Equipment Do I Need?

- Two Handheld Radios
- Handheld Yagi
- Smartphone
 - Satellite tracking app
 - Compass
- Adjust UHF frequency to correct for Doppler (use memories)
- A Voice Recorder is helpful to capture QSOs details as you make them
- Maybe tent stakes to mark rise/set locations
- Maybe helpers to call out directions, frequencies, write log



Making EasySat Contacts

Here is what it looks like!



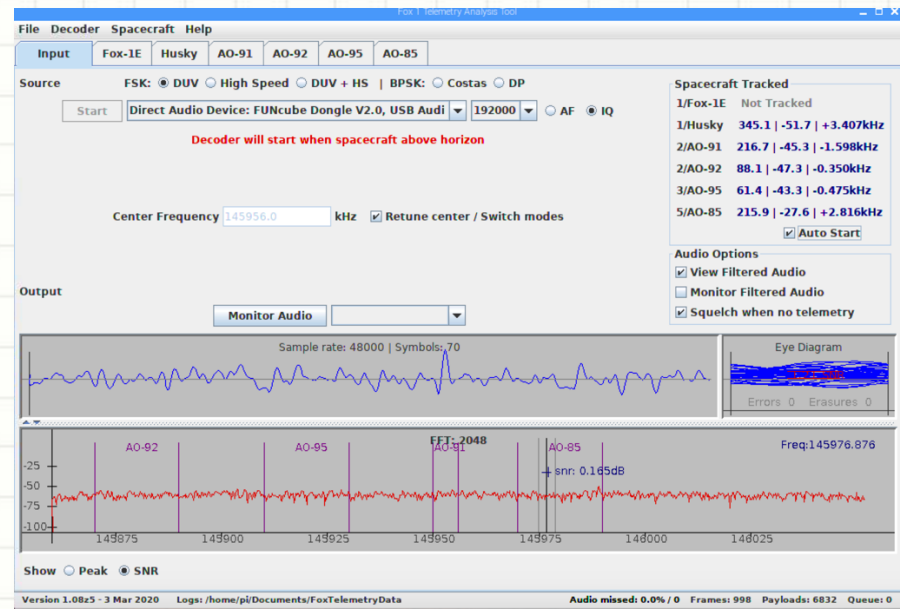
[Video on YouTube](#)

I Love This Stuff

What Else Can I Do?

- Linear Satellites
- Digital Satellites
- Collect SSTV Pictures from the ISS and NO-104
- Receive Telemetry
 - Send to cloud for analysis

Check out amsat.org!



Progressing With Satellites

A Variety of Stations are Possible

- Permanent or semi-portable
- With and without rotators
- Ground mount in the yard, portable in a parking lot, or a dedicated tower
- Circular-polarized antennas for permanent installations
- Computer control for linear satellites
- View our Tech Night for more ideas and info



Questions?

Have Fun!

To Learn More:

Check out the Nashua Area Radio Society's Tech Night Program at:

n1fd.org/tech-night

Become an Internet Subscriber (or members of NARS):

n1fd.org/join-us

Much more information, pictures and video are available on our Blog at:

stationproject.blog

