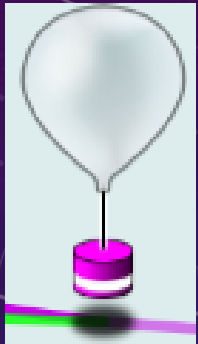




RADIO OPERATIONS FOR AMATEUR BALLOONING



HAMCON COLORADO 2025

OCTOBER 10, 2025

JIM LANGSTED KCØRPS
EDGE OF SPACE SCIENCES



WHAT KIND OF BALLOONS?

- Amateur High-Altitude Balloons
- Weather Balloons
- Pico Balloons



WHAT KIND OF RADIO OPERATIONS?

- On the ground
- In the air



HIGH-ALTITUDE LATEX BALLOONS

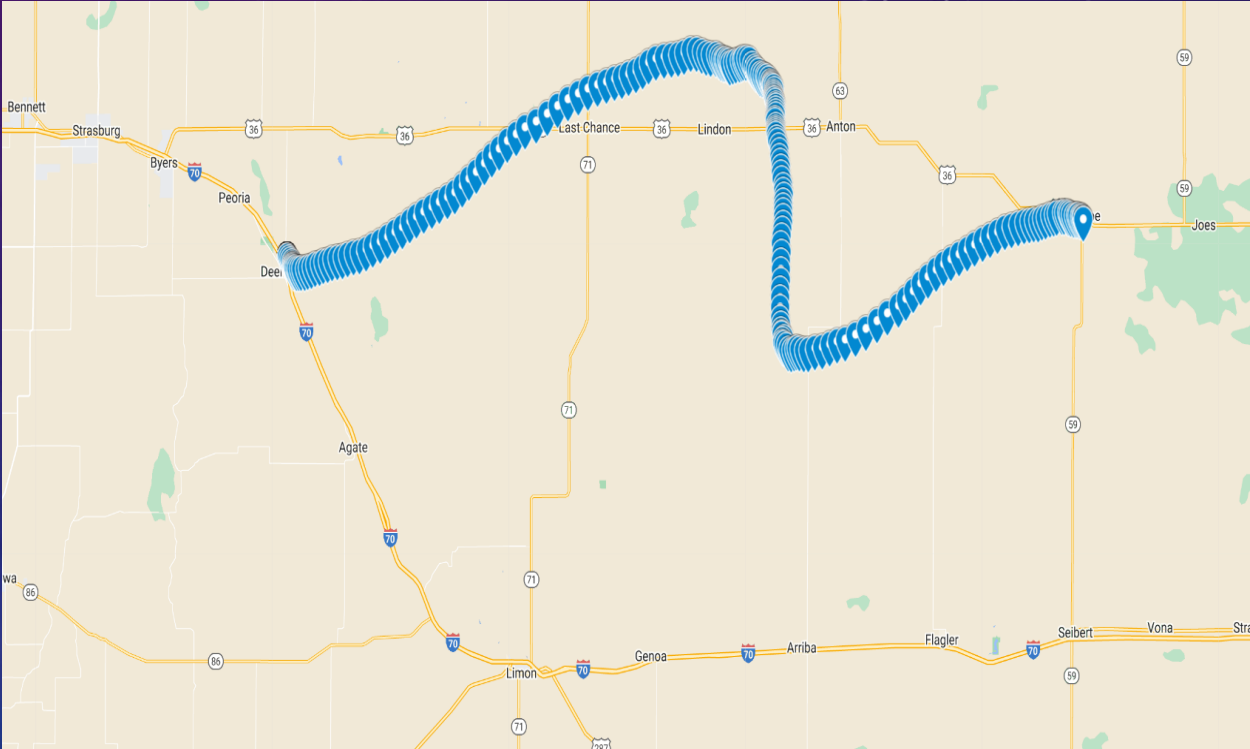
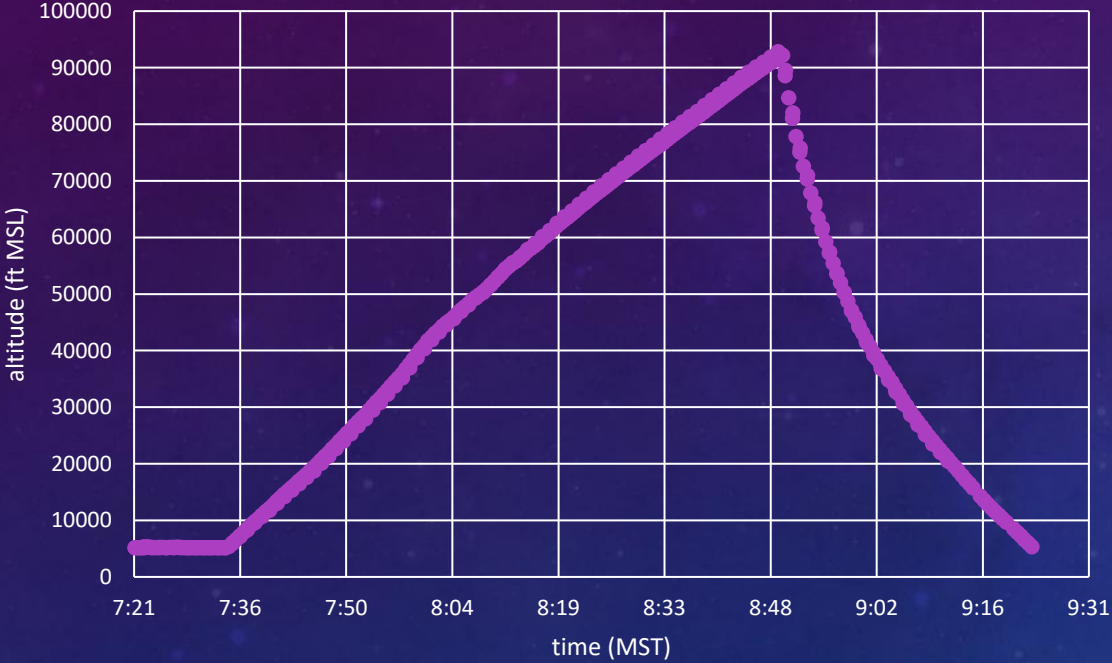
“The Poor Man's Space Program”

- Up
- Track using APRS
- Bursts
- Parachute down
- Retrieve the payloads



FLIGHT PROFILE

EOSS-333 KCOD-1 APRS



ORGANIZED BALLOON LAUNCH

Edge of Space Sciences (EOSS)

- Student Programs
- Months in Preparation
- FAA Coordination
- Designated launch sites



PERSONAL BALLOON LAUNCH

- Small latex balloon
- Homebuilt or purchased beacon
- Launch from “anywhere”
- Track & Recover on your own



SUCCESS TAKES PRACTICE (PPPPPPP)



- Lift Calculation – habhub.org
- Flight Path Prediction
- iPhone - Find my Friends



Result

Burst Altitude: 33000 m
Ascent Rate: 6.14 m/s

Time to Burst: 90 min
Neck Lift: 3552 g

Volume: 5.02 m³
5020 L 177.2 ft³

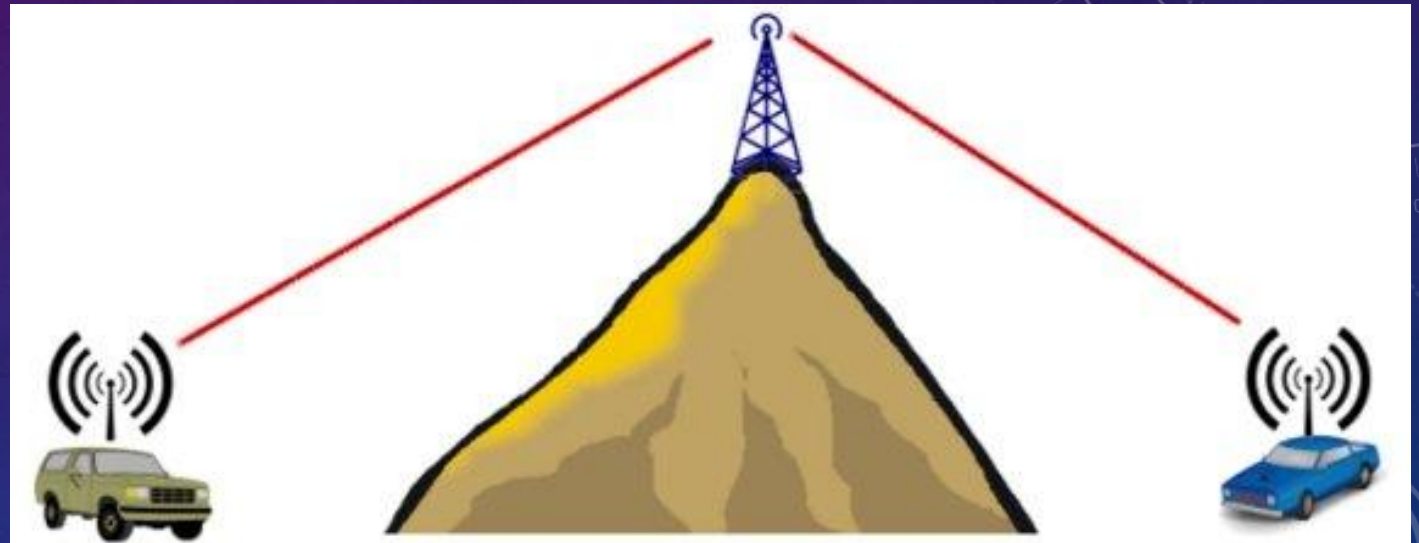
RADIO OPERATIONS – ON THE GROUND

- Tracking Team
 - Watch the balloon come down
 - Drive around listening for the beacon
 - Tracking & Recover Coordinator



RADIO OPERATIONS – ON THE GROUND

- UHF Communications
 - Between vehicles, using:
 - Repeaters
 - Mountain-top (high-gain antenna)
 - Mestaa'ehehe Mountain
 - Pikes Peak
 - Local (few in Eastern Colorado)
 - Cedar Point
 - Hugo
 - Back to Ground Station



RADIO OPERATIONS – ON THE GROUND

- UHF Communications
 - Simplex (between vehicles)
 - Sometimes the only option
 - Inexpensive entry
 - Hand-held
 - Mag mount
 - Next Step
 - APRS mobile in the car



RADIO OPERATIONS – ON THE GROUND

- Ground station



RADIO OPERATIONS – ON THE GROUND

- DMR
 - Rocky Mountain Ham Network
 - Rocky Mountain Wide (TG700)
 - Repeater Locations
 - Thorodin
 - Mestaa'ehehe Mountain
 - Almagre Mountain
 - Limon (Cedar Point)
 - Burlington
 - Portable RMHAM repeaters



RADIO OPERATIONS – ON THE GROUND

- Backup – cell phone
 - Communications
 - Tracking
 - APRS.fi
 - track.eoss.org
 - Assuming cell phone coverage



RADIO OPERATIONS – IN THE AIR

- Radios
 - Power – “line of site is a beautiful thing!”
 - Weight
 - Radios - history
 - Alinco DJ-C5
 - Alinco DJ-C7
 - Radio module – DRA818V
 - VHF
 - 160mW – 800mW



RADIO OPERATIONS – IN THE AIR

- DRA818V
 - VHF
 - 0.5 W– 1W



RADIO OPERATIONS – IN THE AIR

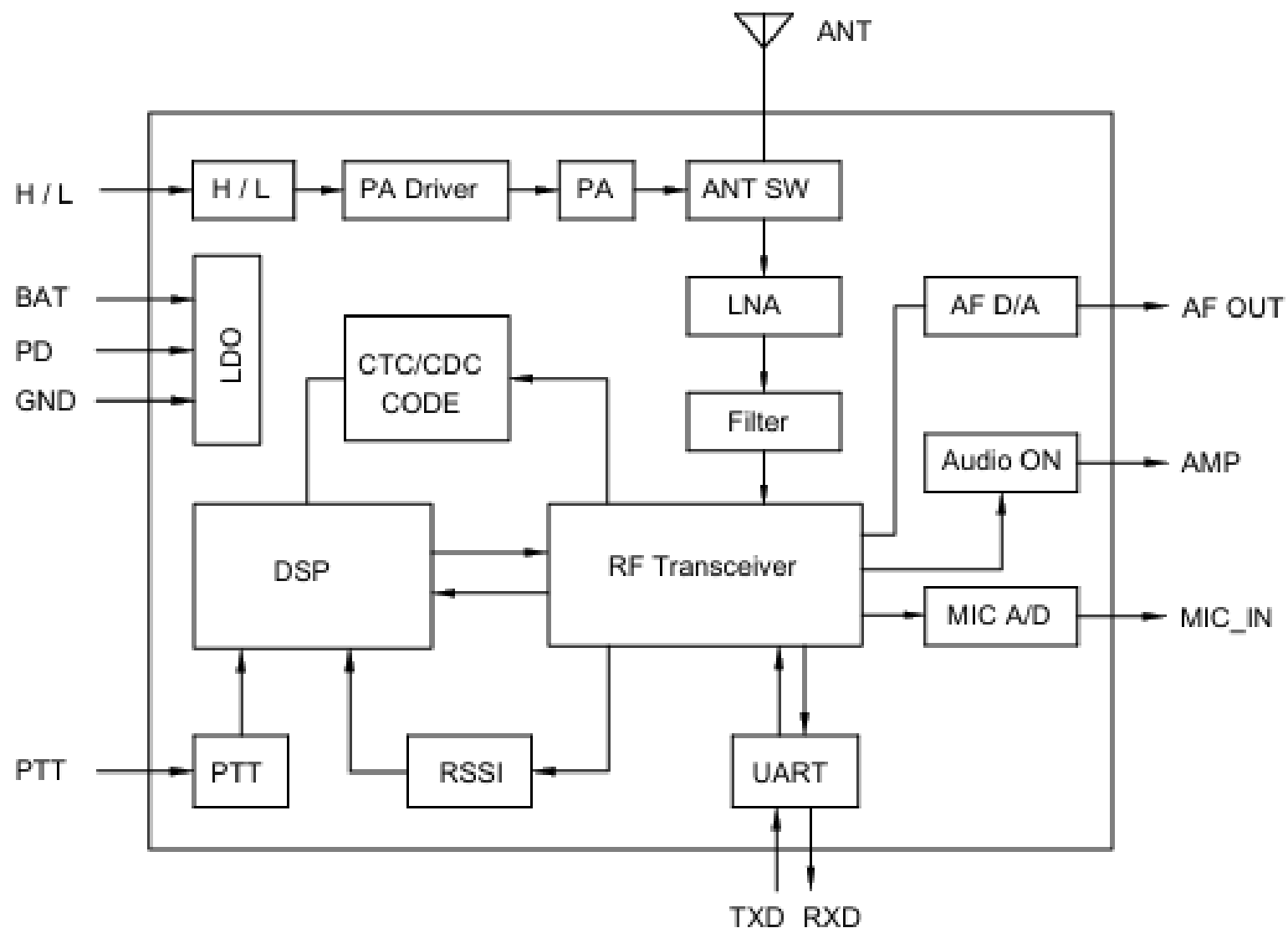
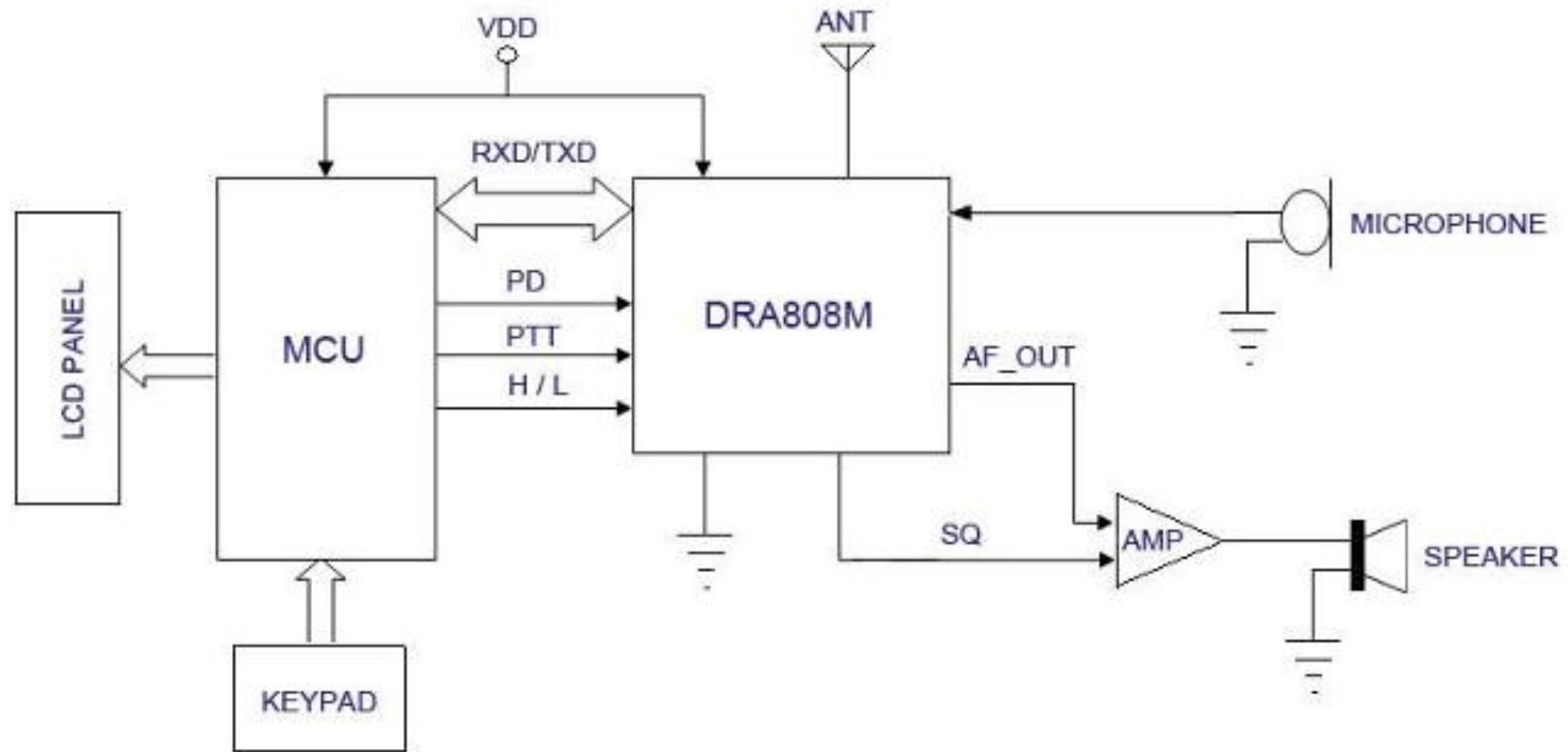
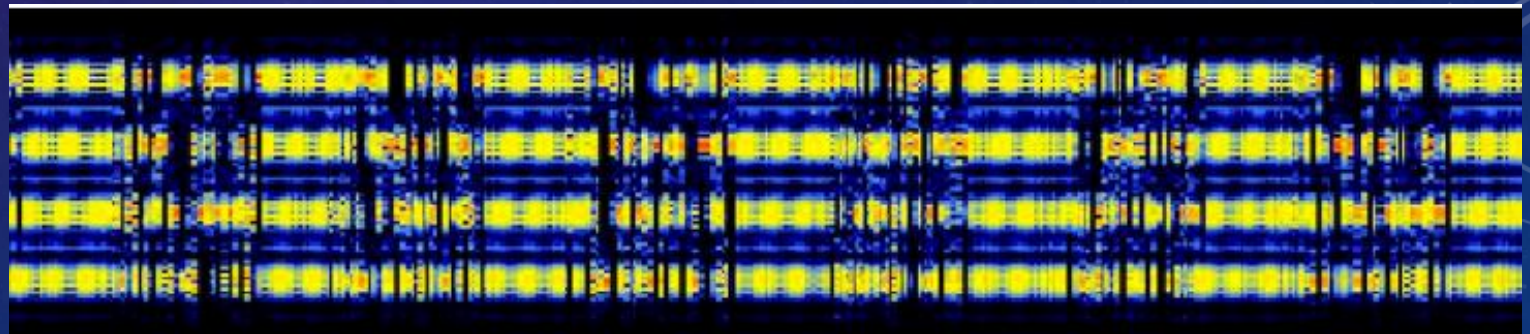


Figure 1: DRA818V Functional Block



RADIO OPERATIONS – IN THE AIR

- Formats
 - APRS – FM, AX.25 frames: lat, lon, altitude, time, comment
 - Horus Binary – SSB, MFSK, forward-error correction, 3-seconds, 7db over RTTY
 - Amateur TV
 - Commercial
 - WiFi
 - Bluetooth
 - LoRa



RADIO OPERATIONS – IN THE AIR

- ADS-B (FlightAware & FlightRadar24)
 - Commercial & Private Aircraft
 - UAV (drones)
 - Kelly Budd SOAR Act
 - “Continuous Aircraft Tracking and Transmission for High Altitude Balloons”
 - Part 101 Modernization Aviation Rulemaking Committee



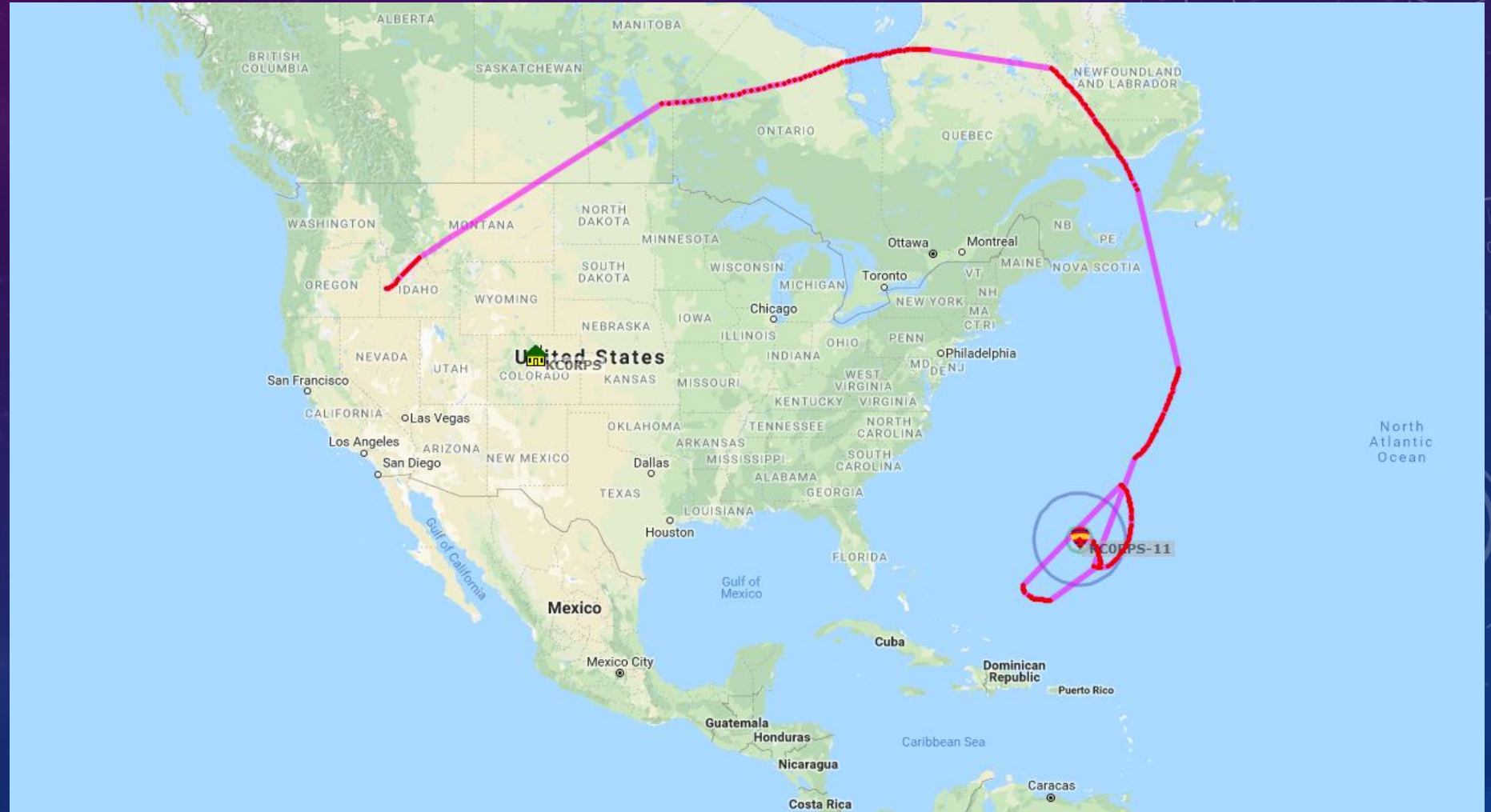
PICO BALLOONS

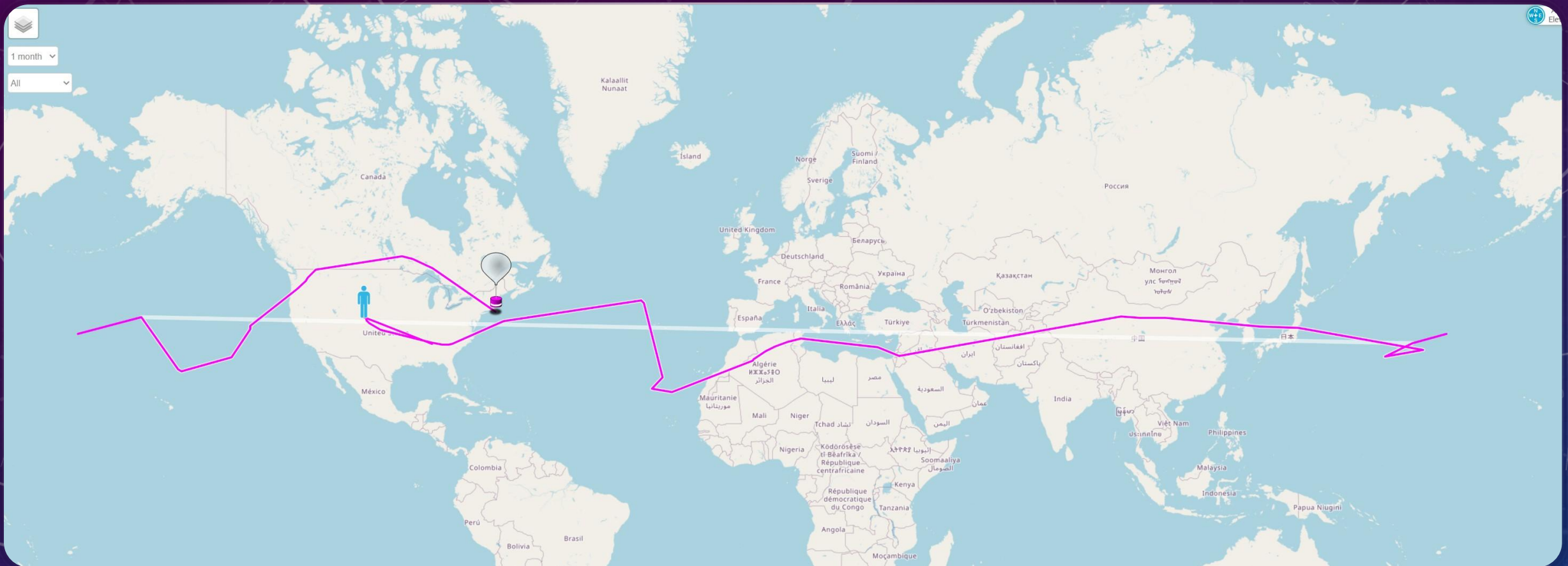
- Small inexpensive balloon
- Very lightweight beacon
- Carefully filled to fly at 40k – 50k feet
 - Above most thunderstorms
 - Into the Jet Stream



FLIGHT PROFILE

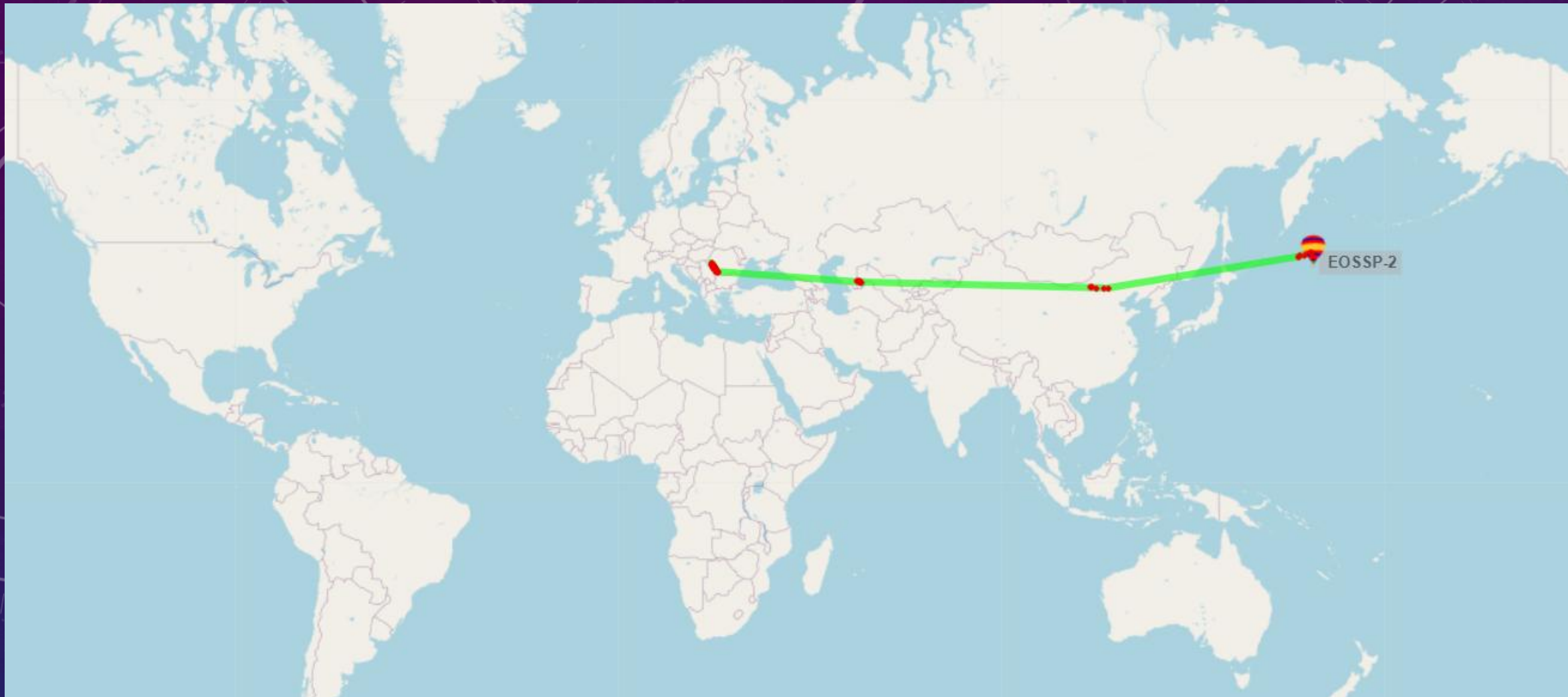
- EOSS first flight





FLIGHT PROFILE

CIRCUMNAVIGATION



FLIGHT PROFILE

CIRCUMNAVIGATION

PICO BALLOONS

- Formats
 - APRS – 2m
 - LOTS of receiving stations – to the web
 - Different frequencies around the world
 - Limited distance
 - WSPR – 20m
 - Many receiving stations – to the web
 - Long-range transmissions
 - Half-wave dipole antenna

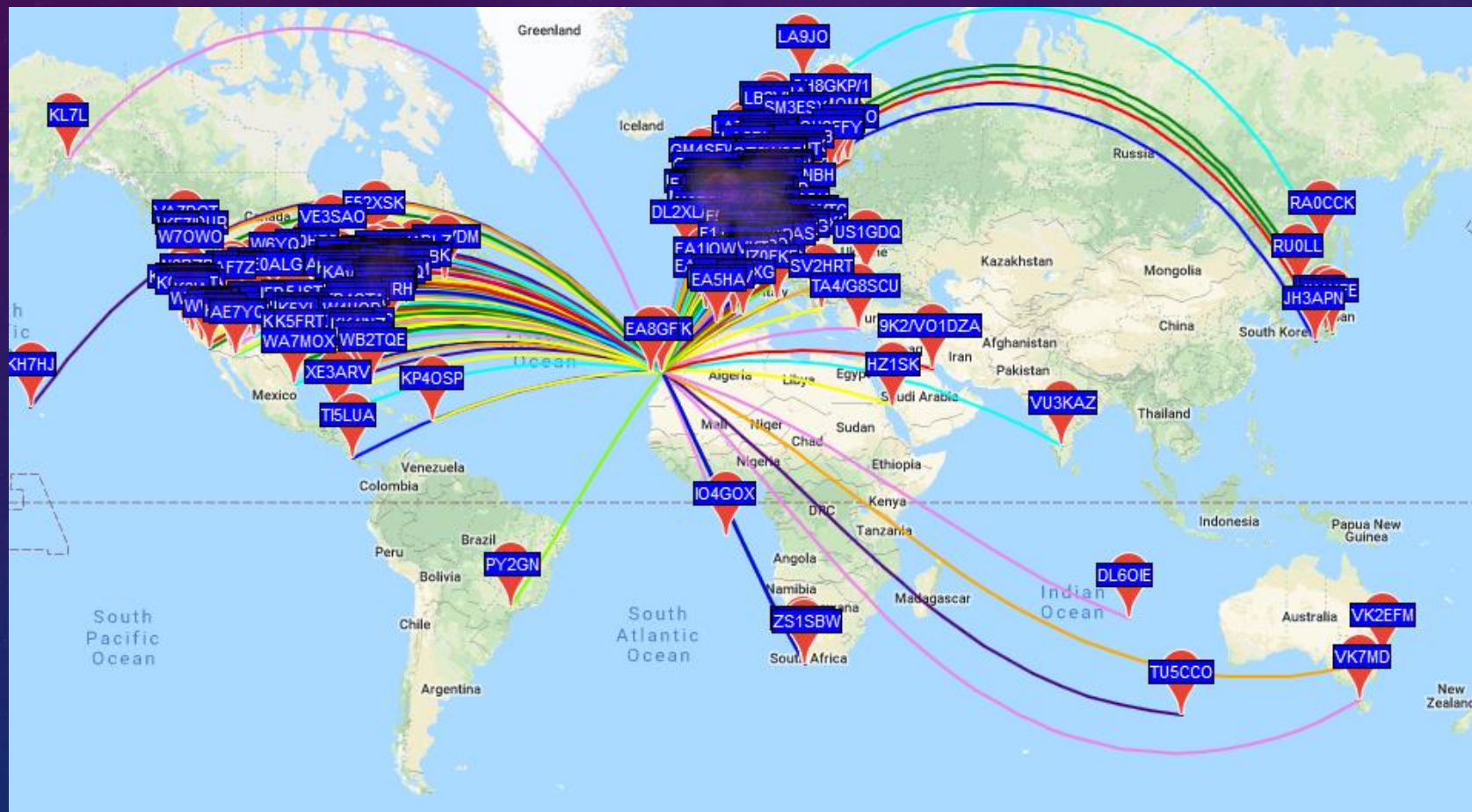
COMMUNICATIONS PROTOCOL

- APRS



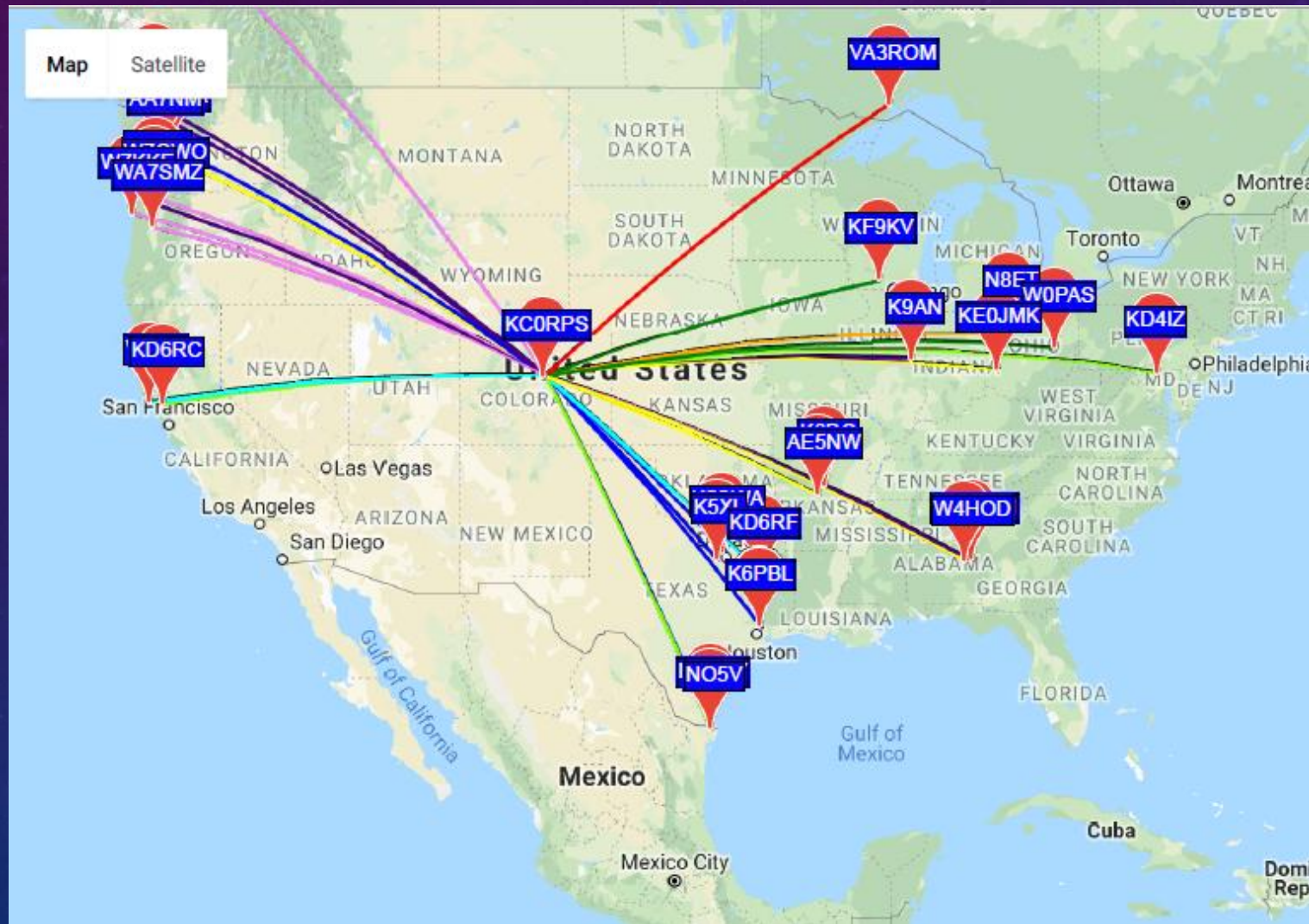
COMMUNICATIONS PROTOCOL (CONT.)

WSPR – 4FSK, call, grid square, transmit power, 111 second transmission



COMMUNICATIONS PROFILE (CONT.)

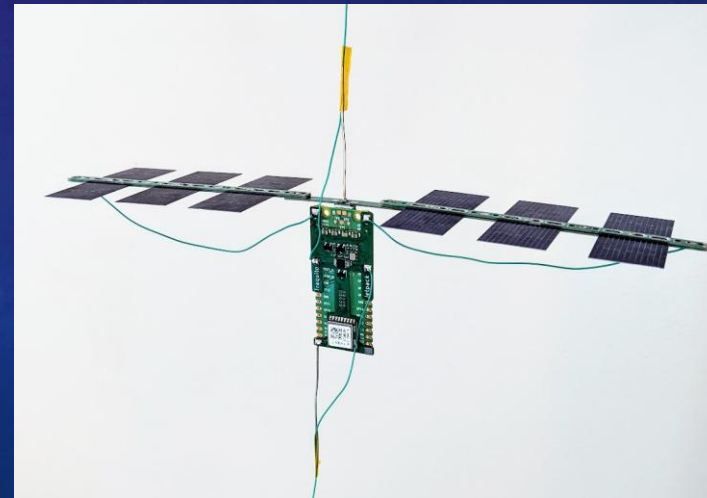
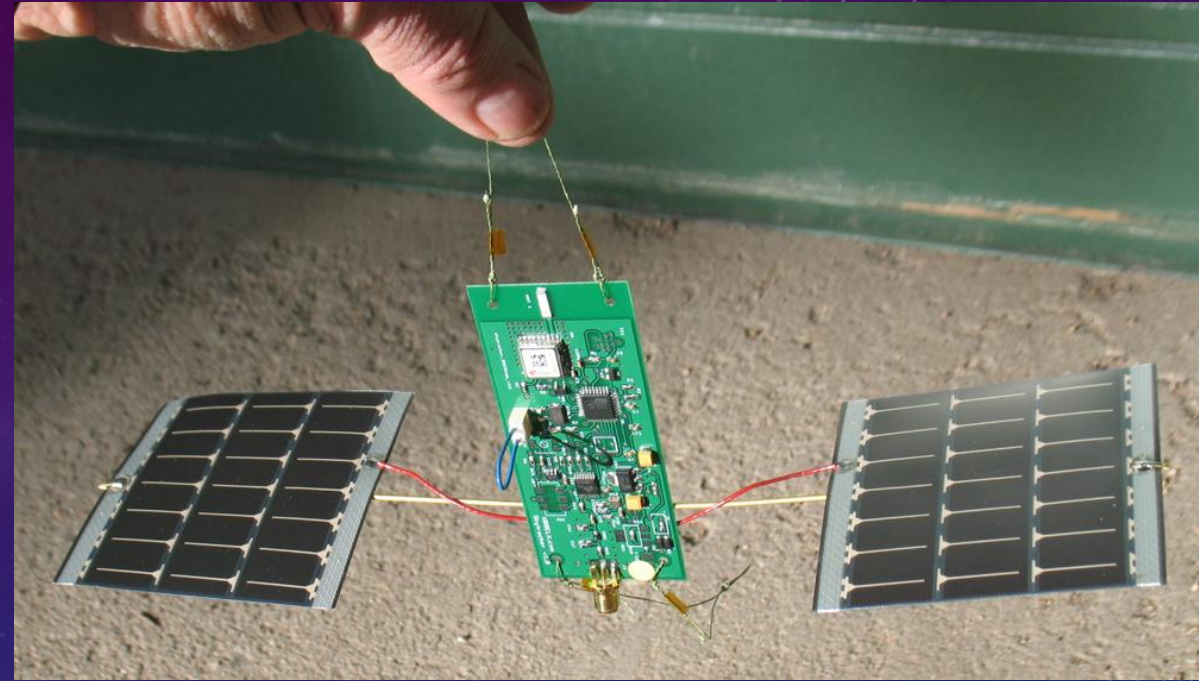
- KCØRPS-11



PICO BALLOONS

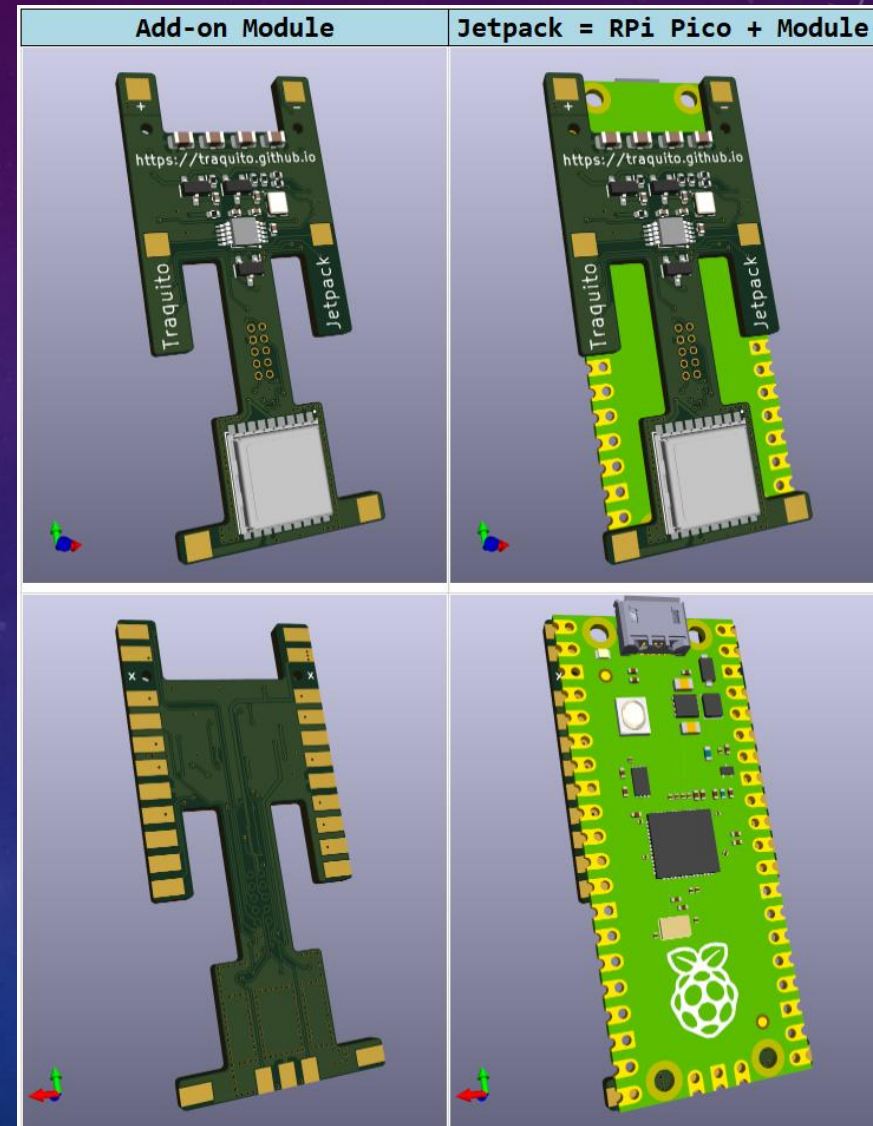


- Beacons
 - Skytracker – WB8ELK
 - QRP Labs - U4B
 - Traquito – traquito.github.io
 - Others



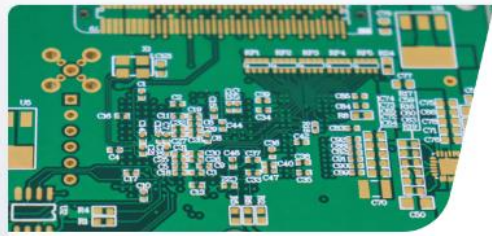
PICO BALLOONS

- Traquito – purchase model
 - Raspberry pi pico board
 - + Add-on module
 - = Jetpack
 - Drag & drop firmware
 - Online configuration



PICO BALLOONS

- Add-on module
 - Not available to purchase
 - Files available for JCLPCB manufacture
 - gerber files (PCB design)
 - BOM (bill of materials)
 - cpl (parts placement file)



1 - 4 Layers

From **\$2** /5pcs | Build Time: 24 hours

- 1-2L - \$2 for 100×100mm PCBs
- 4L - \$2 for 50×50mm PCBs
- FR4, Aluminum, Copper, Rogers, PTFE

[Quote Now](#) [Learn More >](#)



PCB Assembly

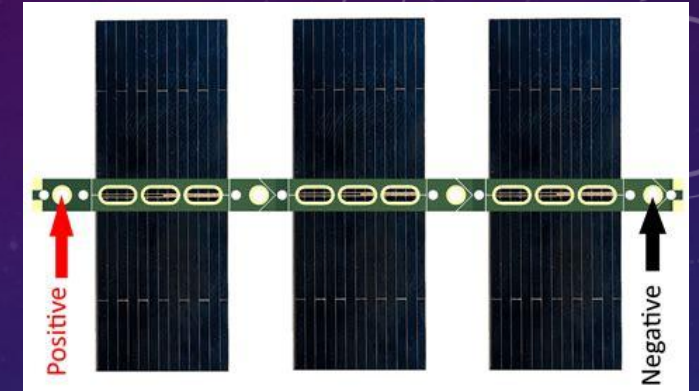
From **\$8** /5pcs | Build Time: 24 hours

- 560,000 + In-stock Parts
- Free DFM File Check
- Support Rigid and Flex PCBs

[Quote Now](#) [Learn More >](#)

PICO BALLOONS

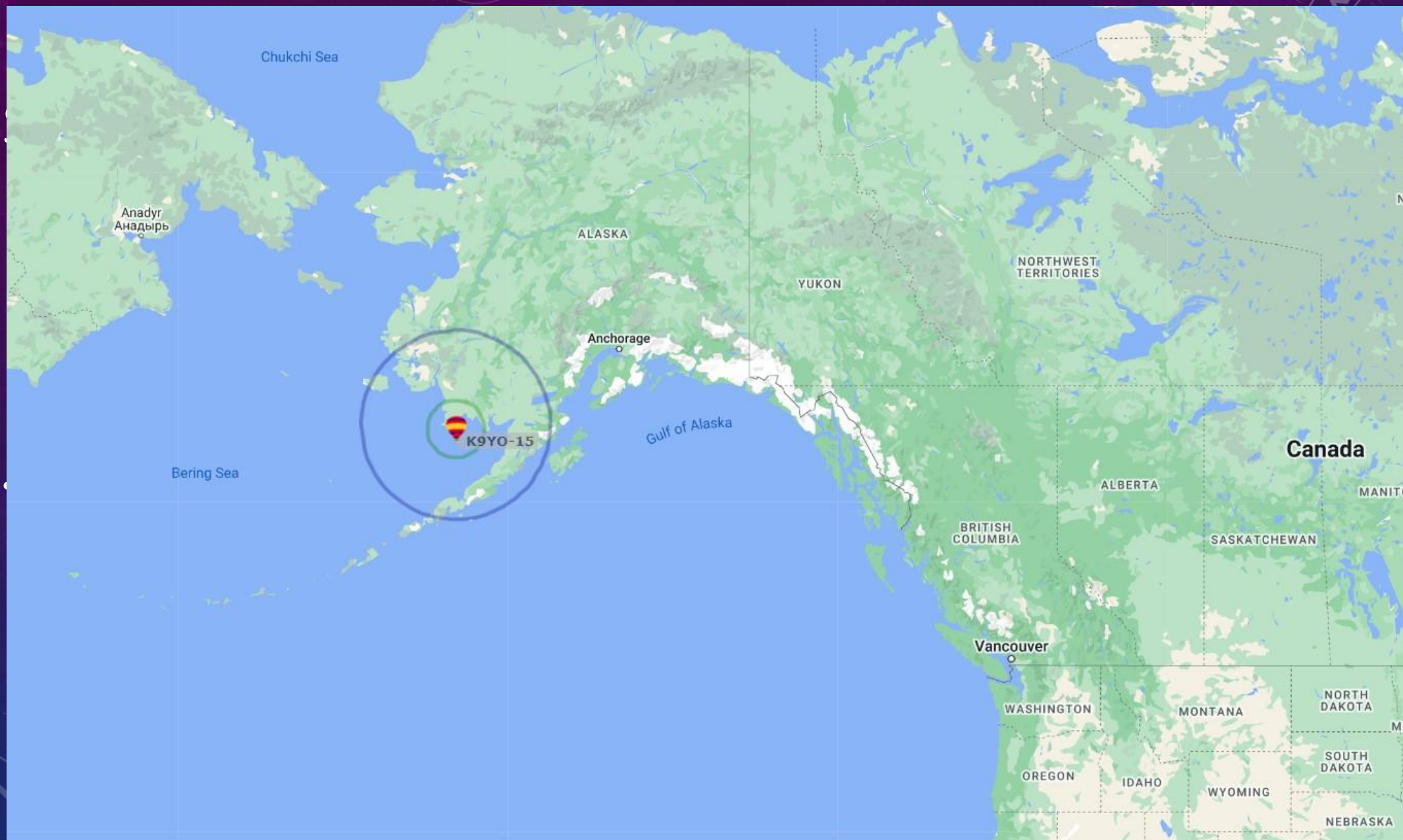
- Also required
 - Balloon
 - Pre-stretching equipment
 - Helium/Hydrogen
 - Antenna
 - Solar panels or batteries
 - supercapacitor?



SHOOTDOWNS

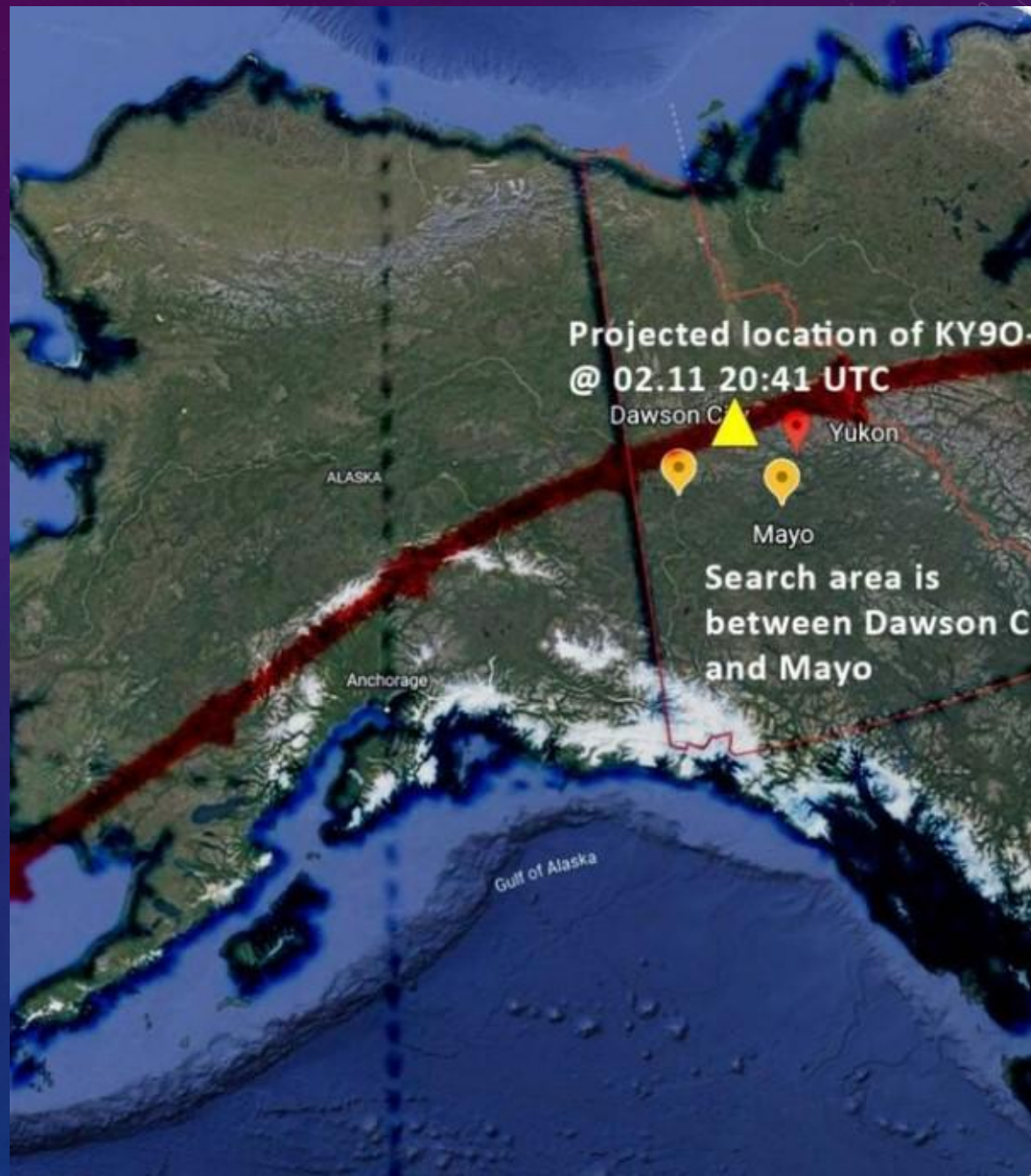


- K9YO-15 – Yukon
- WB0EMJ-9 – Lake Huron (timing is wrong)

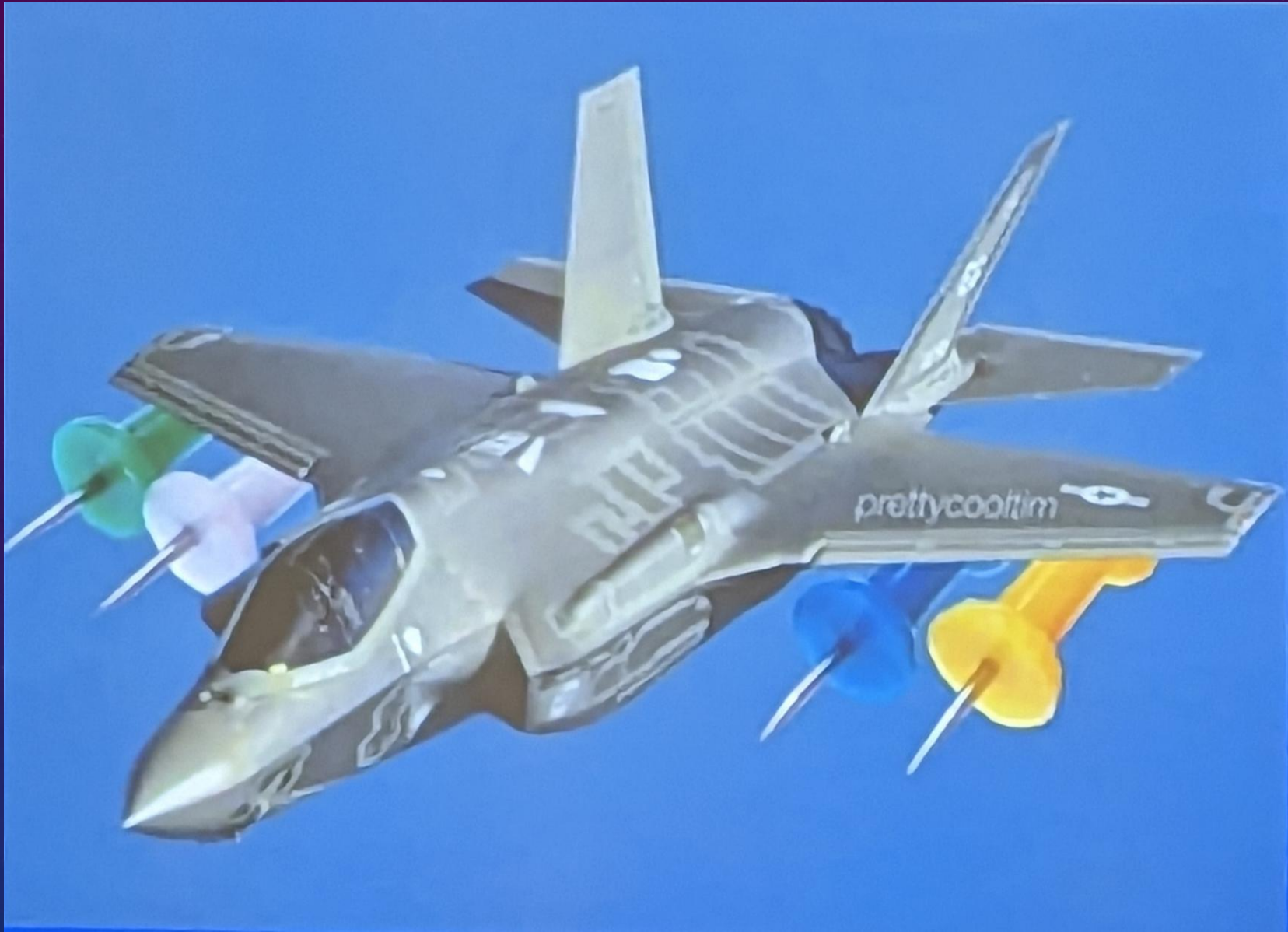


SHOOTDOWNS

- K9YO-15 – Yukon







BUILD YOUR OWN BEACON

- APRS down
 - GPS
 - TNC
 - Transmitter
- Commands up
 - Receiver
 - DTMF decoder
 - Actuator

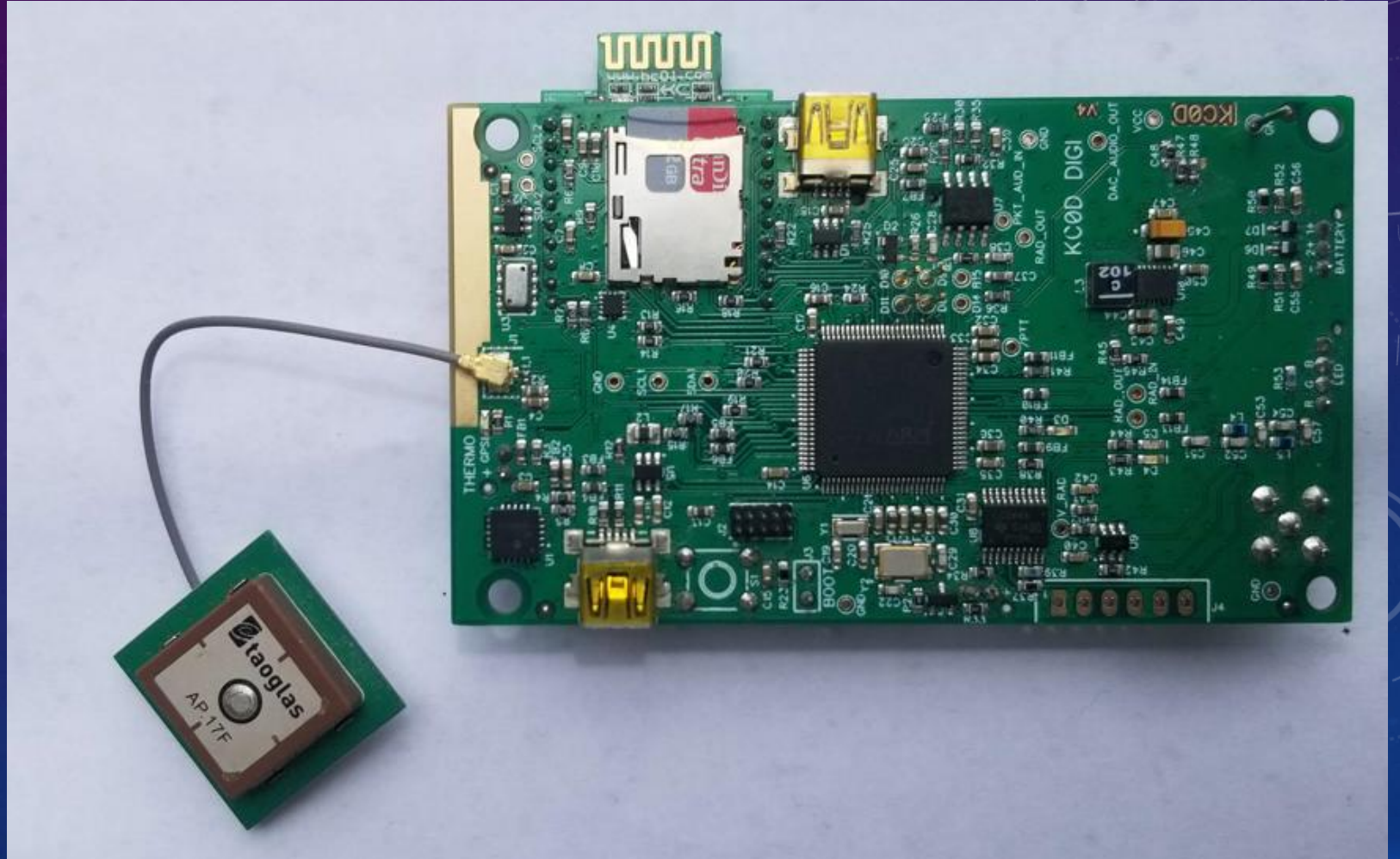


BUILD YOUR OWN BEACON



BUILD YOUR OWN BEACON

- APRS down
 - GPS – setup commands
 - TNC – build your own
 - 2FSK
 - AX25 protocol
 - APRS String
- Transmitter
 - Setup commands
 - Clean signal - Filter



TECHNICAL REPORT



卓時檢測
TIMEWAY TESTING LABORATORY



ISO/IEC17025 Accredited Lab.

Report No: FCC 1106180
File reference No: 2011-07-18

Applicant: FUJIAN NAN'AN BAOFENG ELECTRONICS CO., LTD

Product: Two Way Radio

Model No: UV-3R

Trademark: BAOFENG

Test Standards: FCC Part 90

Test result: It is herewith confirmed and found to comply with the requirements set up by ANSI C63.4 and FCC Part 90, regulations for the evaluation of electromagnetic compatibility

Approved By
Jack Chung

Jack Chung
Manager

Dated: July 18, 2011

Results appearing herein relate only to the sample tested
The technical reports is issued errors and omissions exempt and is subject to withdrawal at

SHENZHEN TIMEWAY TECHNOLOGY CONSULTING CO LTD

5/F Block 4, Anhua Industrial Zone, No.8 TaiRan Rd. CheGongMiao, FuTian District, Shenzhen, CHINA.

Tel (755) 83448688

Fax (755) 83442996



ARRL TEST REPORT: Spurious Emission

Callsign: *KCØRPS* Date: *5/18/2012*

Manufacturer: *BAOFENG* Model: *UV3R*

Power Output: (Band 1), *1.5* (Band 2) *1.8W*

Maximum Allowable Spurious Emission: *-47.5* *-49* dBm (Band 1/2)

Band 1 *2M* Bands 2: *440*

2nd Harmonic Level: *-35* dBm *-70* dBm

3rd Harmonic Level: *-70* dBm *-70* dBm

4th Harmonic Level: *-70* dBm *n/a* dBm

Highest Spur Level: *-35* dBm *-70* dBm

Passed FCC Standards _____ Failed FCC Standards _____

ARRL Test Engineer(s): *John Gull 100K12*

Matt Zapetka AG4BB

* FCC Part 97.307(e) The mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency between 30-225 MHz must be at least 60 dB below the mean power of the fundamental. For a transmitter having a mean power of 25 W or less, the mean power of any spurious emission supplied to the antenna transmission line must not exceed 25 µW and must be at least 40 dB below the mean power of the fundamental emission, but need not be reduced below the power of 10 µW. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

Minimum Suppression Needed:

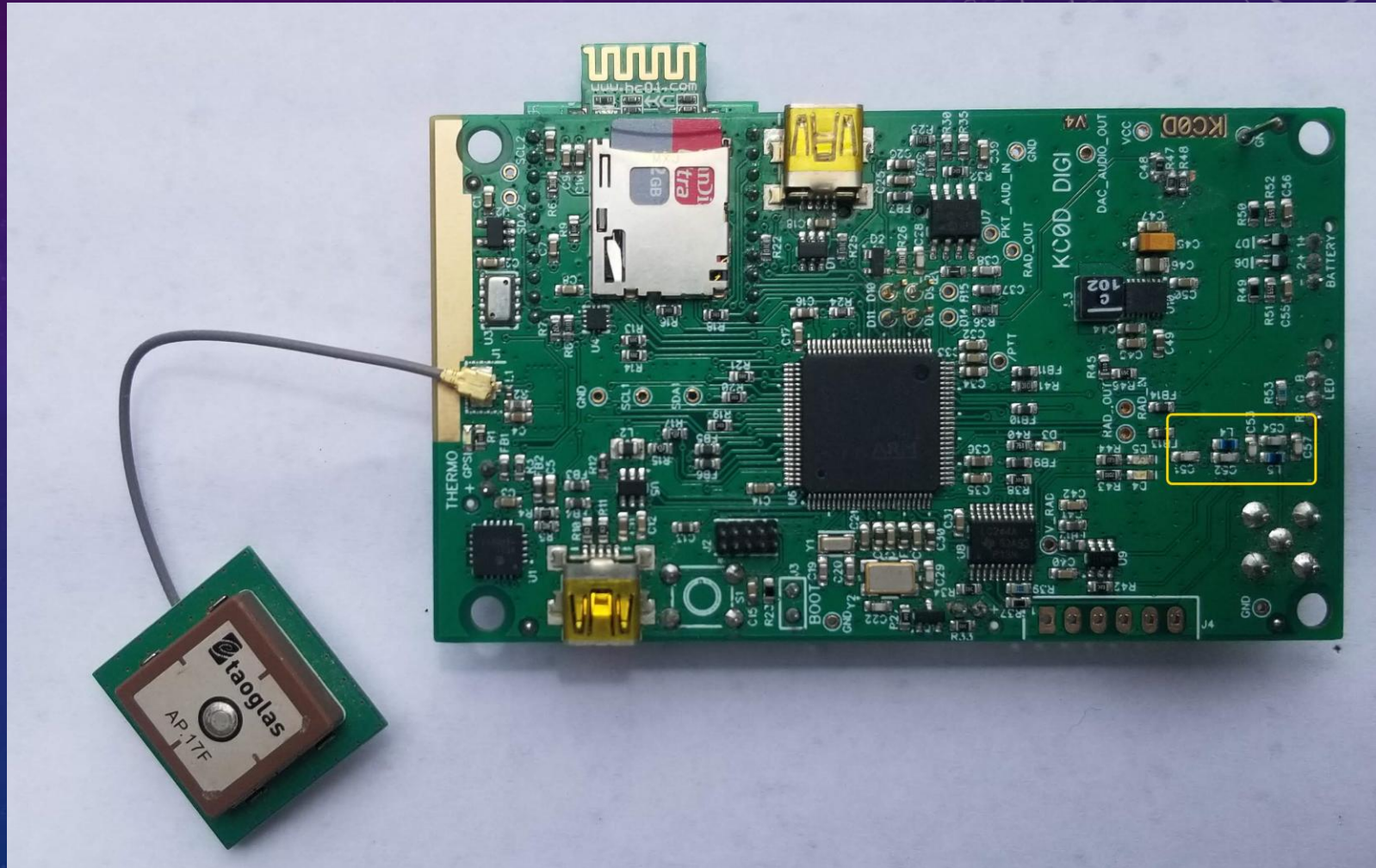
6W=53.8 dB, 5W=53 dB, 4W=52 dB, 3W=50.8 dB, 2W=49 dB, 1W=46 dB, 100mW=36 dB.

ARRL THE AMATEUR RADIO ASSOCIATION

Rev2 02-04-2011

BUILD YOUR OWN BEACON

- Filter - low-pass
 - Filter Design – ELSIE (LC) software
 - SimSmith – tweak it
 - TINA – Model it
 - Build it
 - Spectrum analyzer

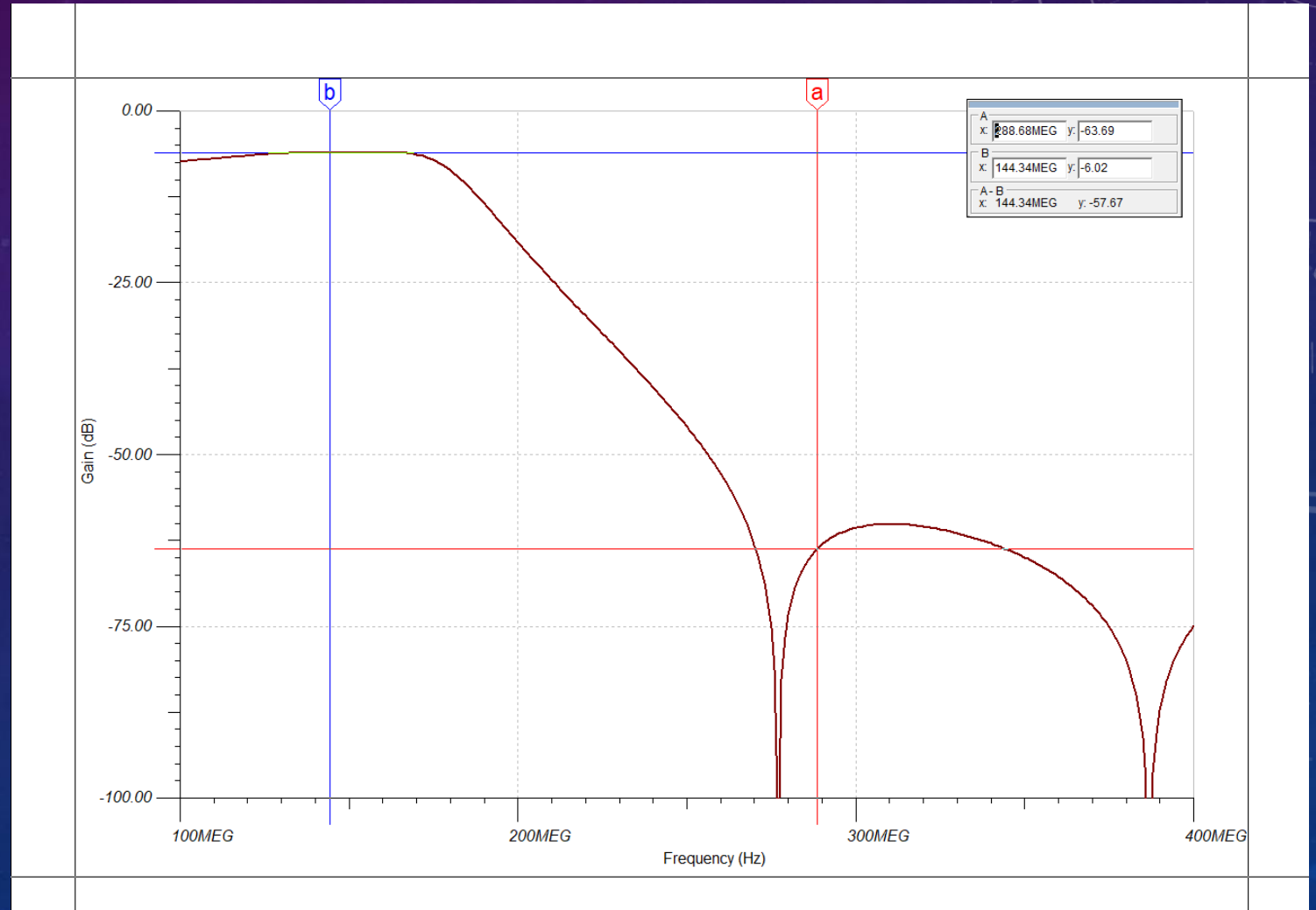


- Filter - low-pass
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L	C2	LC2	D	LC1	A	G
R = 50 X = 0 ←W 0.970 ↑V,i=6.964,0.1393	R = 17.33 X = -23.78 ←W 0.971 ↑V,i=6.964,0.1913	R = 17.55 X = 14.09 ←W 0.983 ↔v,i=8.962,0.2366	R = 17 X = -14.18 ←W 0.984 ↑V,i=5.326,0.3023	R = 17.27 X = 23.78 ←W 0.999 ↔v,i=9.133,0.2406	R = 49.94 X = 1.372 ←W 1.000 ↑V,i=7.069,0.1908	SWR = 1.028 Γ = 13.7m∠92
50ohms 0johms <none> file	30pF 2KQ 0@MHz	4.3pF 36nH 404.5MHz 200Ql 2KQc 0@MHz unlockFreq LC	62pF 2KQ 0@MHz	11pF 30nH 277.1MHz 200Ql 2KQc 0@MHz unlockFreq LC	29.48pF 2KQ 0@MHz	145.7MHz 50Zo xMlch Plots Plt

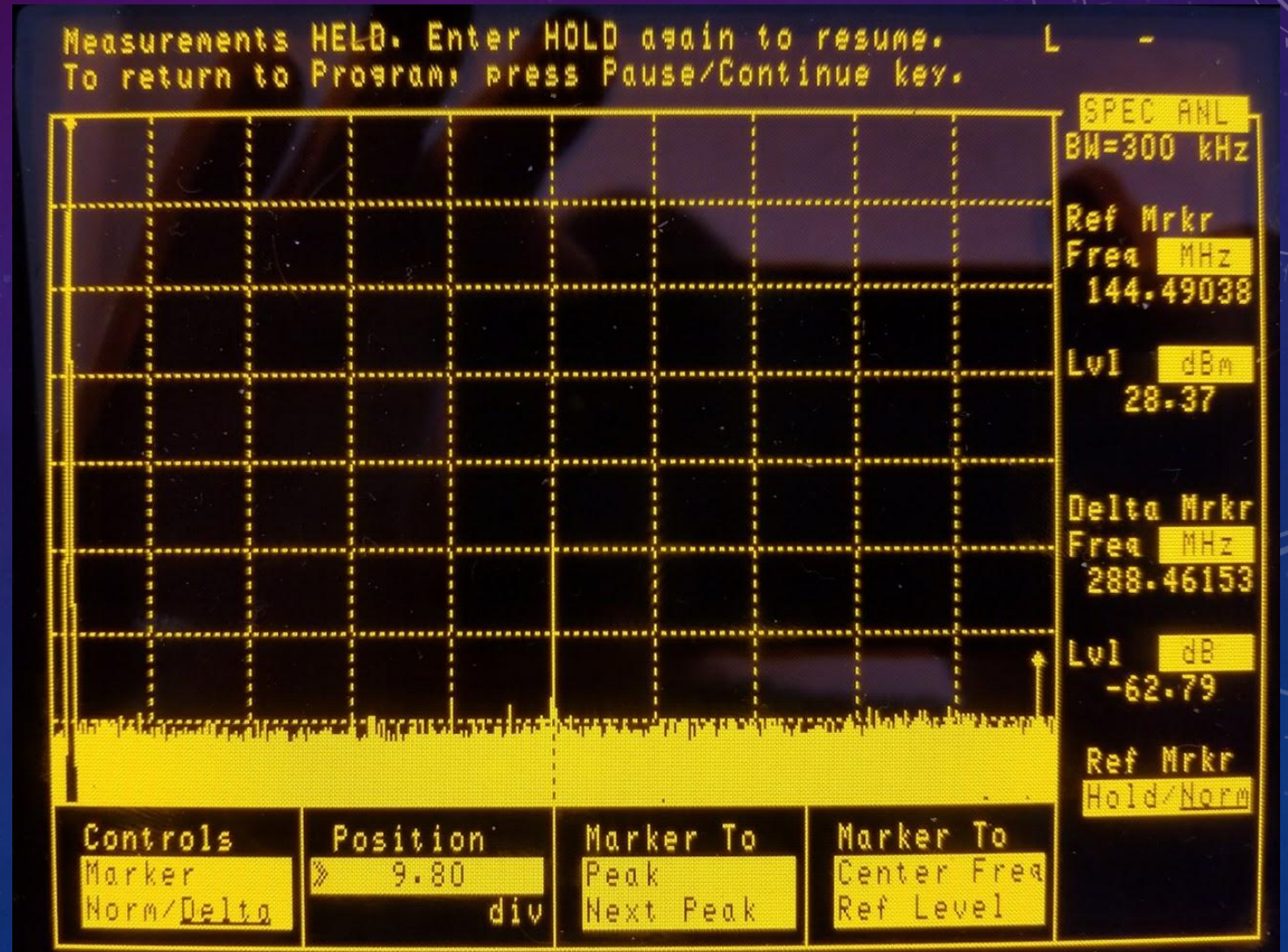
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BUILD YOUR OWN BEACON

- Filter - low-pass
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BUILD YOUR OWN BEACON

- Mechanical Issues (if you want to reuse it)
 - Minimal wiring
 - Mechanical attachment
 - Top & bottom protection
 - Antenna attachment
 - Battery attachment
 - Locking connectors
 - Don't open it up
 - Switches on outside



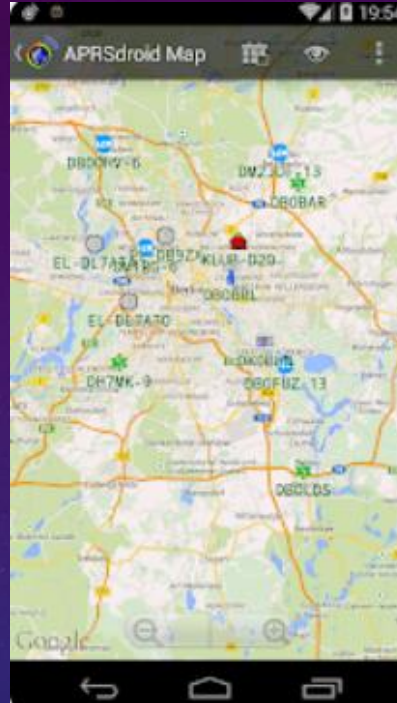
BUILD YOUR OWN BEACON

- Packaging
 - $\frac{1}{4}$ " foam core
 - Tape
 - colorful
 - Thru tube
 - Antenna connector



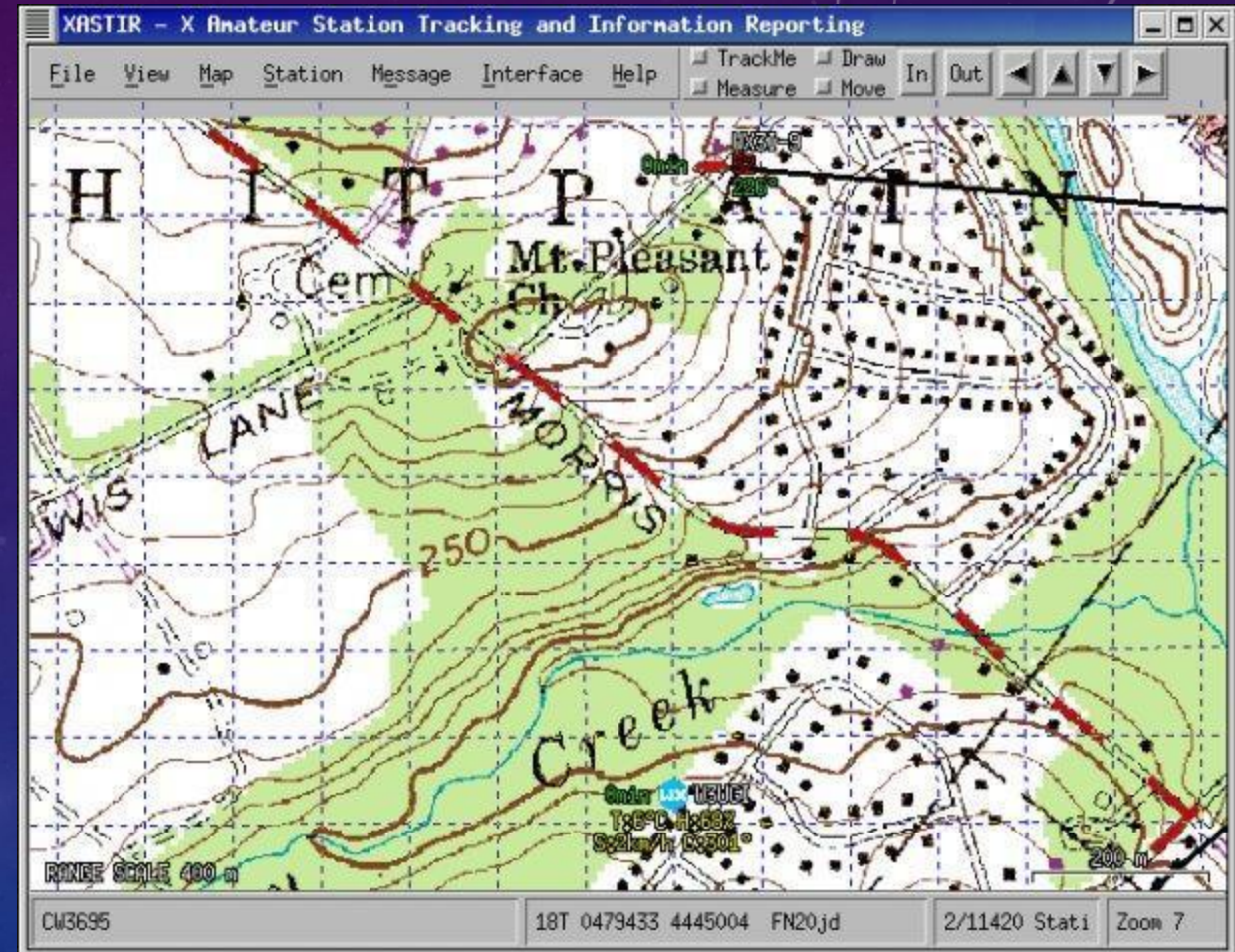
RECEIVING STATIONS

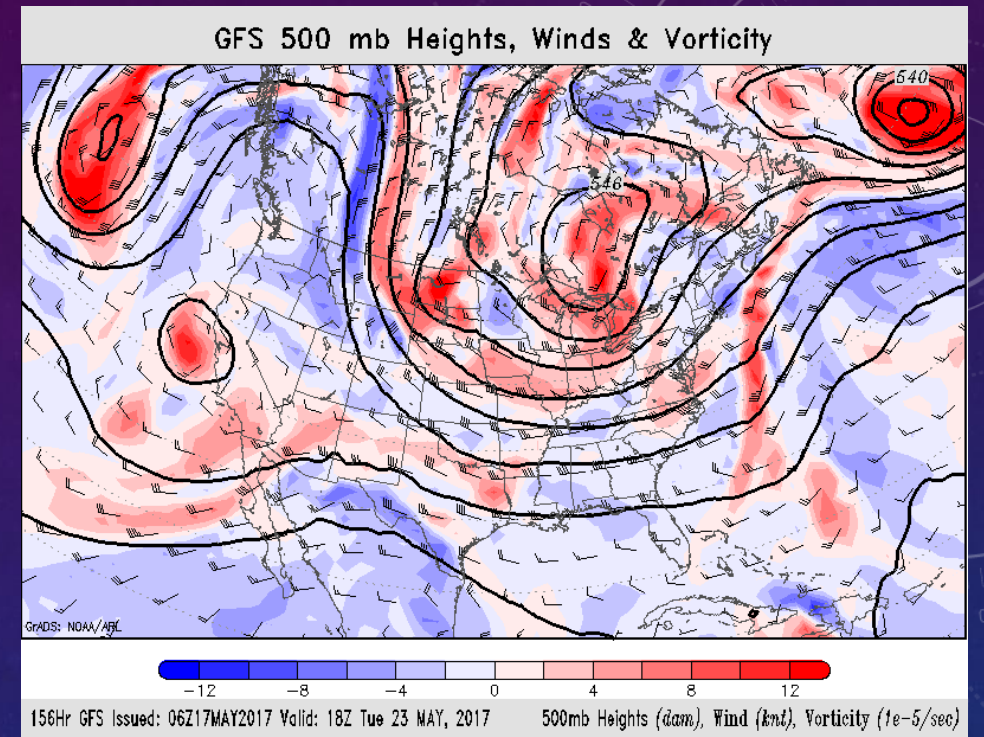
- APRS.fi or track.eoss.org
- DF Antenna & Handheld
- Receiver (APRS capable)
 - APRS Mobile
 - APRS Handheld
- Receiver (FM)
 - Decoder
 - TNC
 - Direwolf



RECEIVING STATIONS

- Mapping Program
 - Windows
 - UIVIEW – Roger Barker G4IDE SK
 - APRSIS32
 - PinPoint APRS
 - YAAC – “(mostly) platform-independent Java application”
 - Xastier - linux





WEATHER BALLOONS – RADIOSONDES

A NON-AMATEUR ACTIVITY

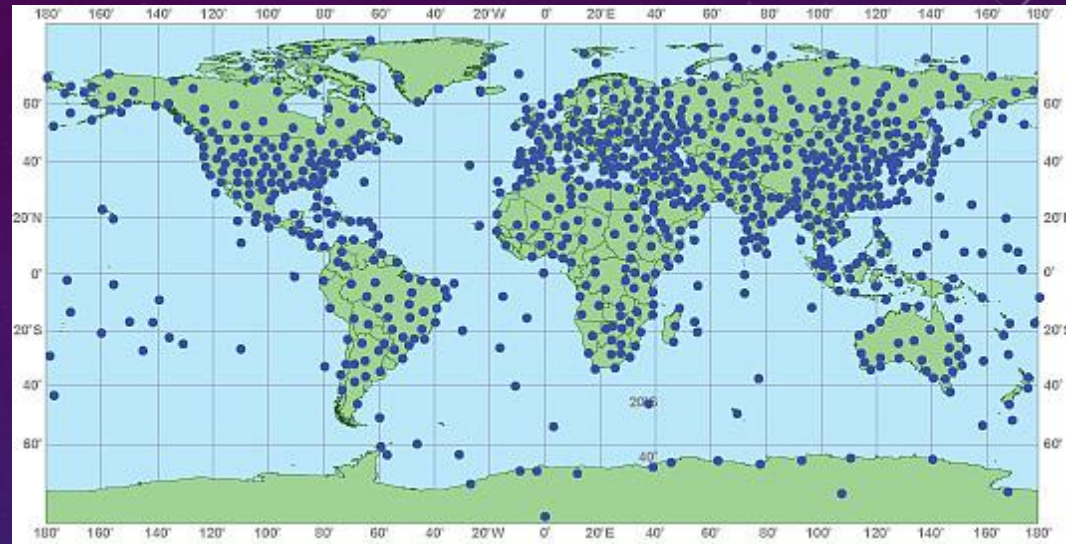
OVERVIEW

- Hydrogen or Helium-filled latex balloon
- Controlled ascent to burst
- Parachute descent
- Radiosonde beacon
- Upper air data
 - Pressure
 - Temperature
 - Relative humidity
 - GPS position
- 1679 MHz or 403 MHz communications



EXTENT

- Since the late 1930's
- Over 1,300 upper-air stations worldwide
- NWS - 92 locations
- Launch at same time, 0:00 and 12:00 UTC



EQUIPMENT

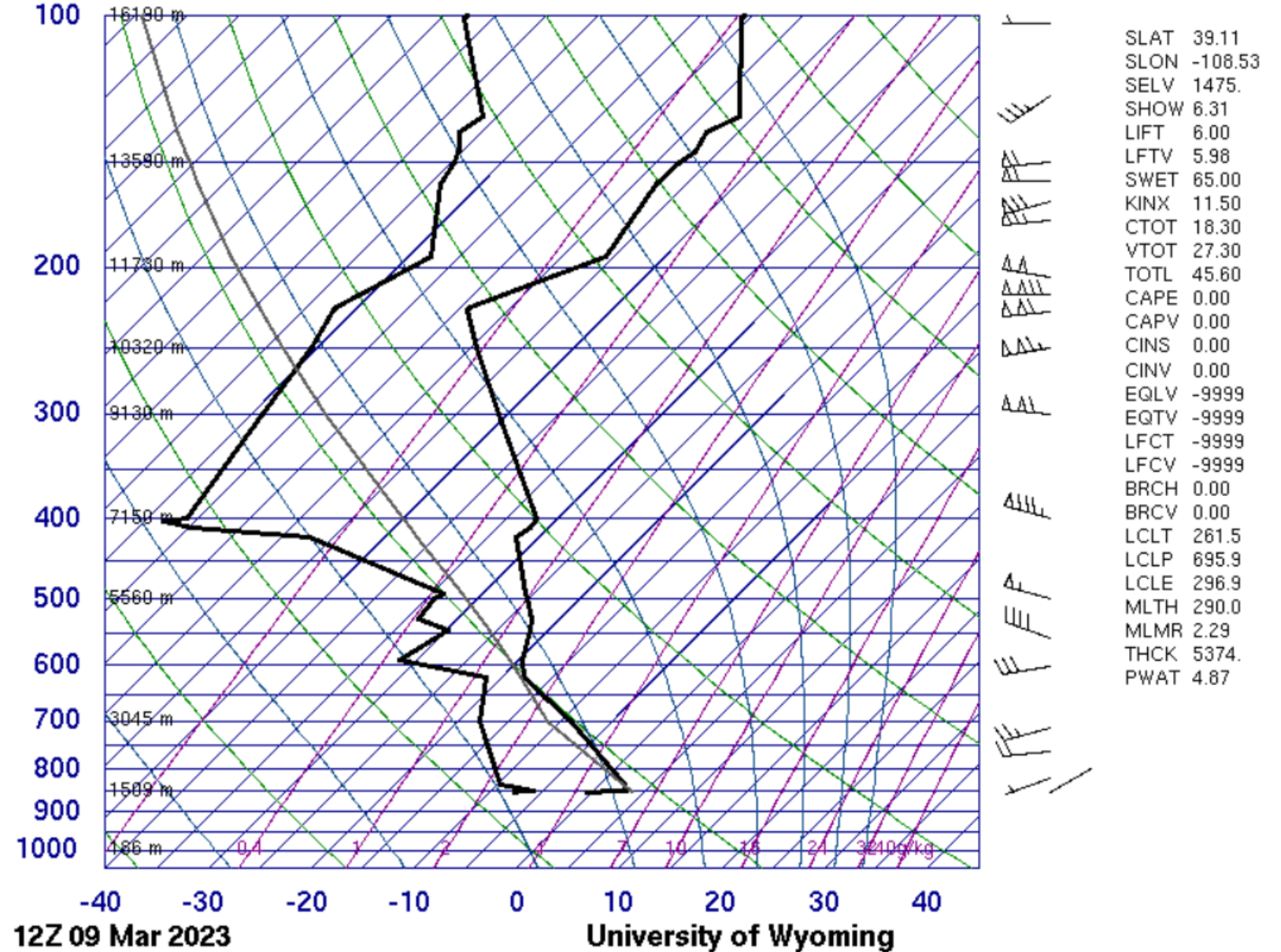
- Balloon Size – 5 ft → 25 ft 600g
- Radiosonde 250g – 500g (9oz – 18oz)
- Parachute – 48 inch plastic



PURPOSE

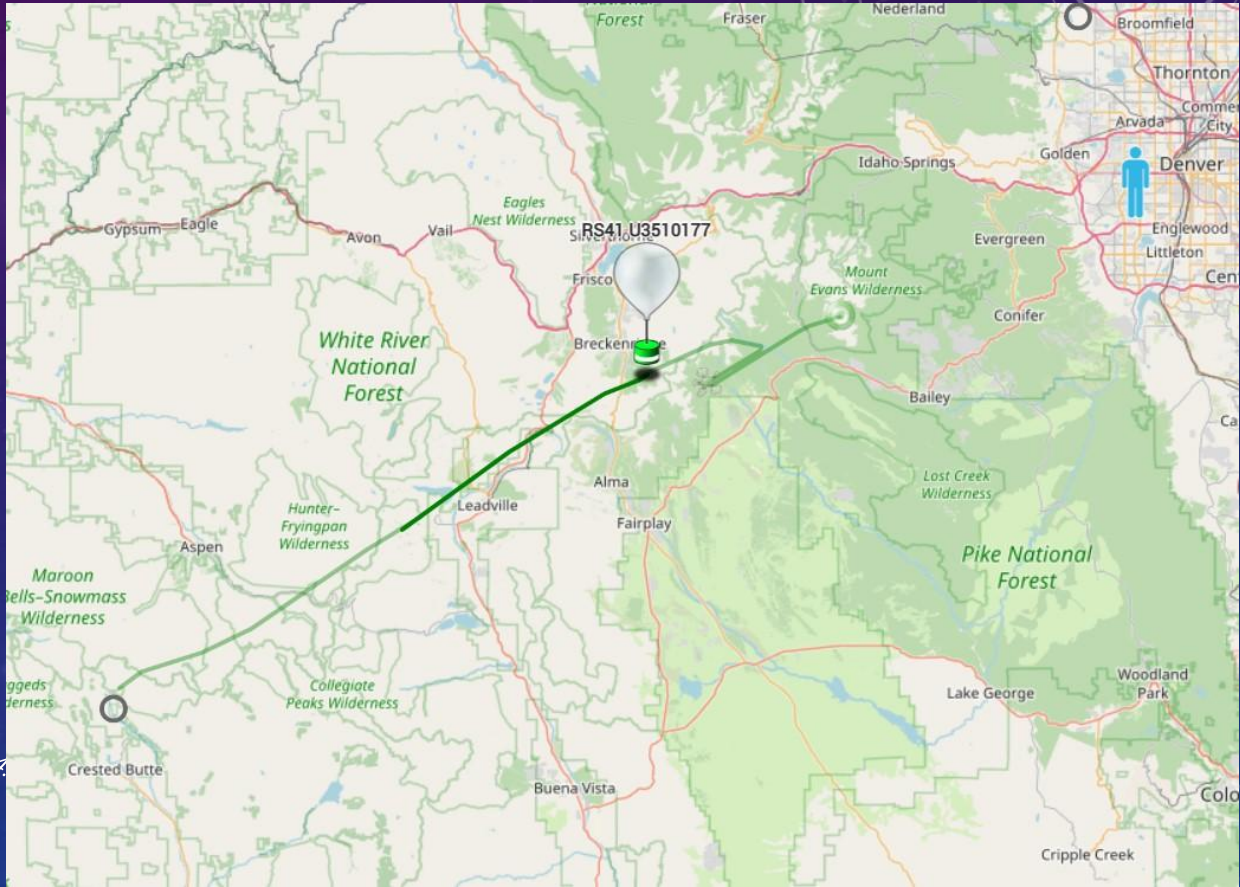
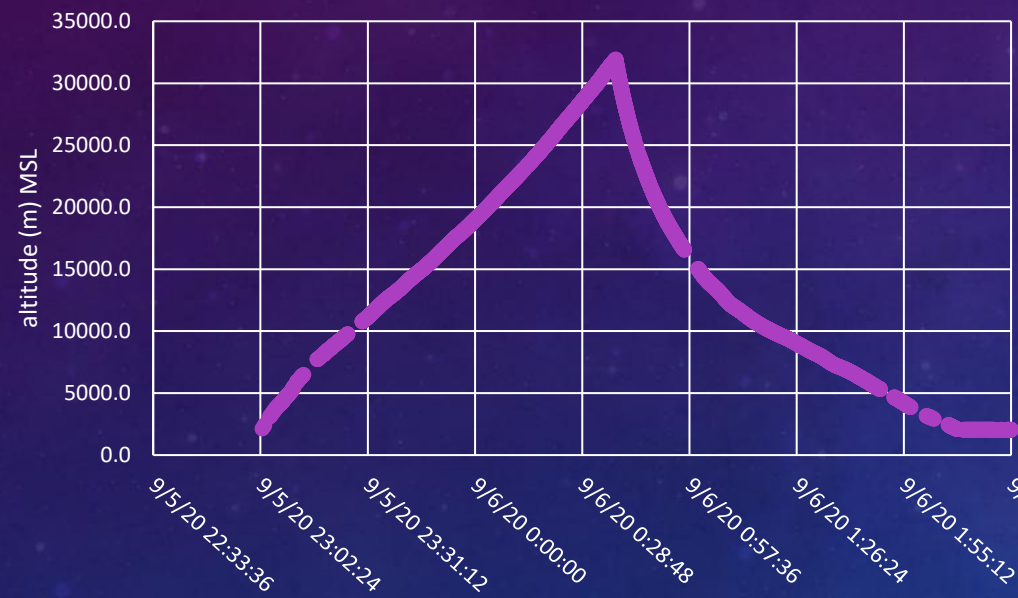
- NWS model input
- Skew-T Chart

72476 GJT Grand Junction



FLIGHT PROFILE

2002-09-06 00Z Radiosonde



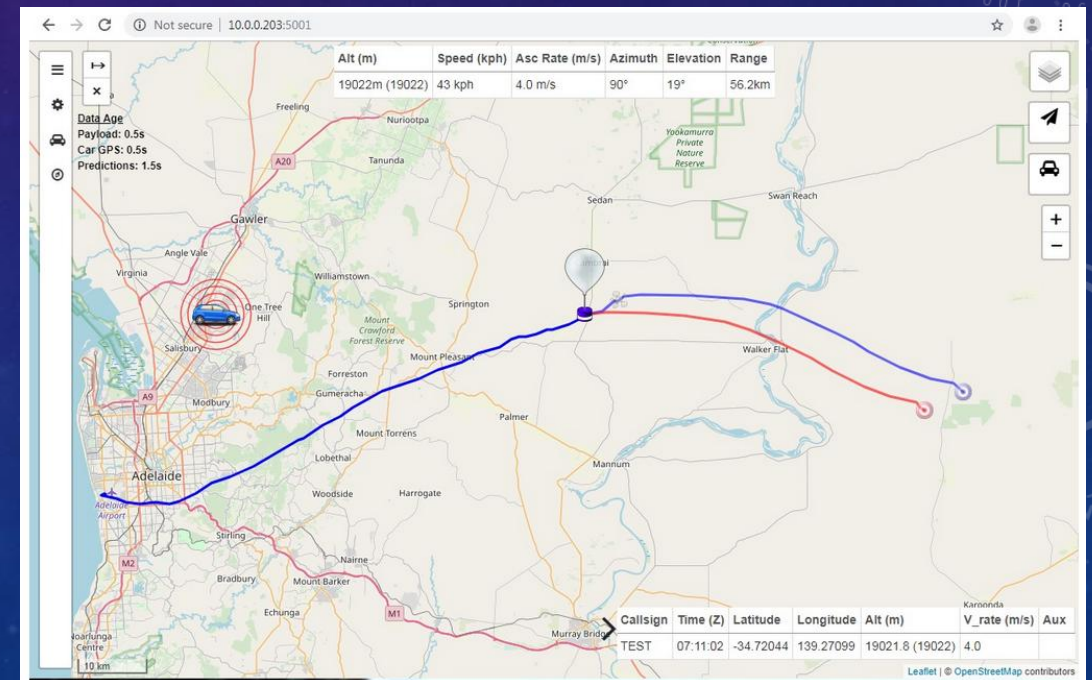
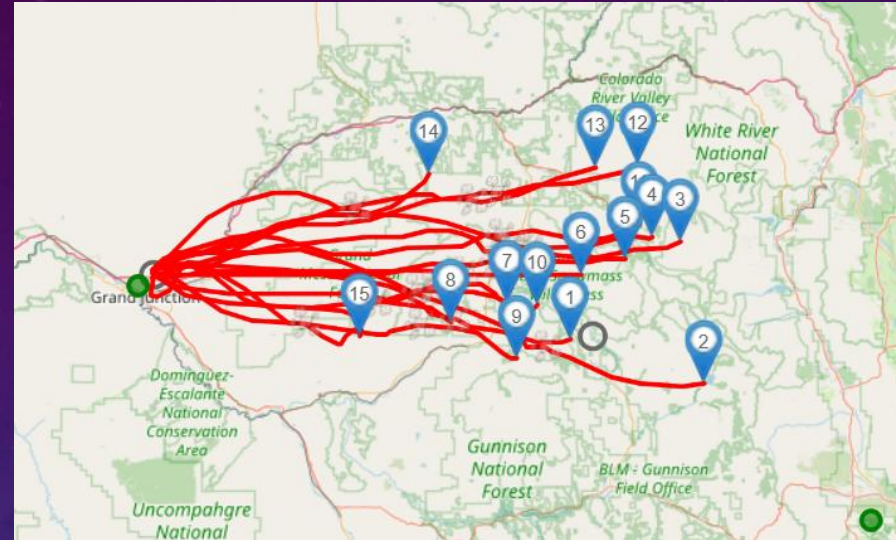
COMMUNICATIONS PROTOCOL

- Different for each model
- Smart hobbyists develop software to receive & decode
- Tracking system for the car



TRACKING & RECOVERY

- NWS Tracking
 - Ground stations
 - Only interested up to about 55,000 ft
- Hobbyist Tracking
 - Predictions
 - Web tracking
 - Field tracking



WEB TRACKING



IT'S FUN TO DO!

