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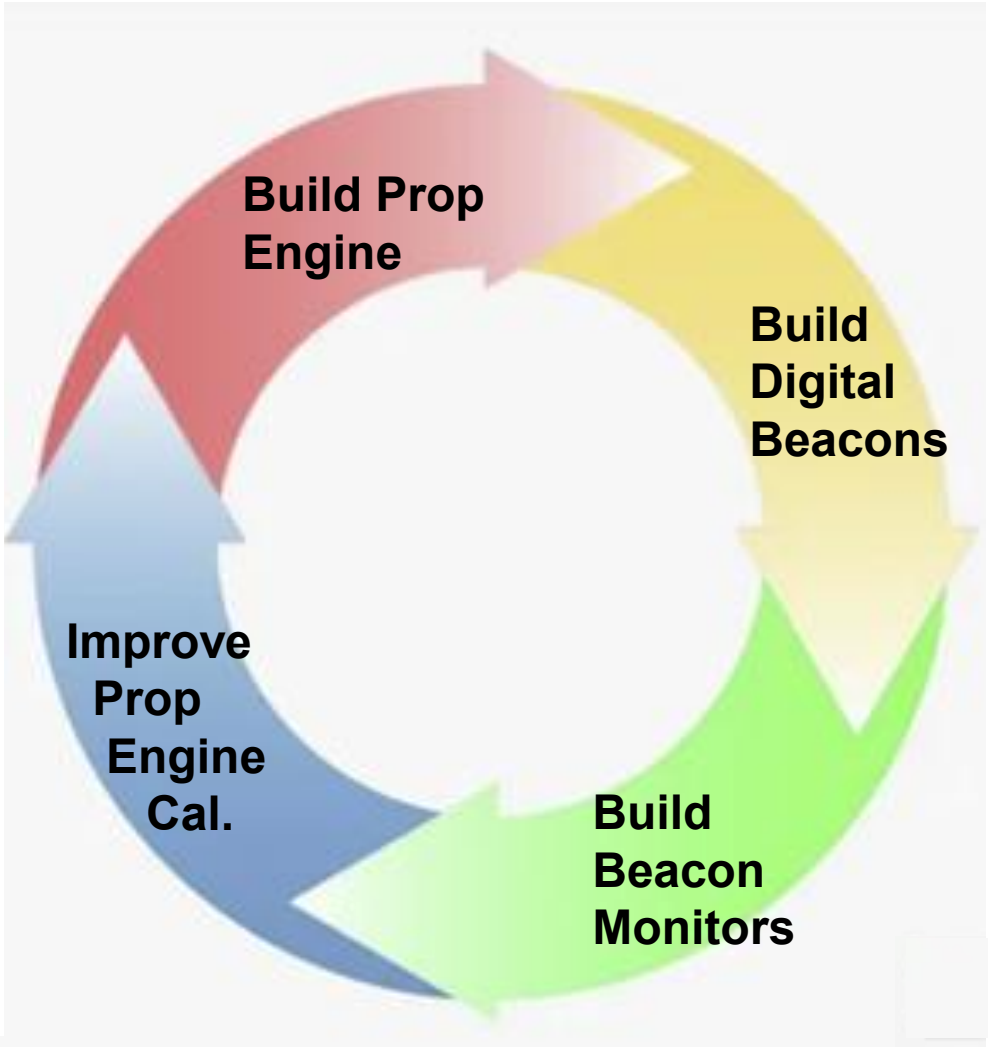
Empirically Calibrated Propagation Forecasting for SHF and EHF Amateur Paths

Microwave Update
Rochester, N.Y.

James McMasters km5po@arrl.net

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How is this performed?



Build a propagation engine

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- Create a database of actual microwave contacts.
  - 75K and growing
  - 19 bands, 902 Mhz to 411 GHz
  - ARRL contest logs 1991 to present.
  - Commercial terrestrial links at 11/24/68 GHz.
    - Historical dataset from March 14-29 2026 (18,540 samples) was used for initial algorithm validation.
  - User submissions, single and ADIF imports.

Build a propagation engine

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- A.I. was used to integrate ITU formulas
  - **P.453-14** The radio refractive index
  - **P.452** Interference prediction, 0.1–50 GHz
  - **P.526-16** Propagation by diffraction
  - **P.530** Terrestrial line-of-sight systems
  - **P.676** Attenuation by atmospheric gases
  - **P.838** Rain attenuation model
  - **P.837** Rainfall rate for prediction
  - **P.1812** Path-specific point-to-area

Build a propagation engine

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- Integrate data sources
  - **HRRR v4** 3 km / hourly / 18 h
  - **HRDPS** 2.5 km / 4× daily
  - **GEFS** ensemble mean / day 2–7
  - **NARR** 32 km / 3-hourly / 1979–2014
  - **RAOB** soundings via IEM
  - **NEXRAD** n0q composite reflectivity
  - **IEMRE** 0.125° gridded hourly
  - **GIRO DIDBase** foF2 / foEs / hmF2
  - **SNMP links** 7 commercial, 11/24/68 GHz
  - **NTMS beacon monitors**, 10/24/47 GHz

Scoring/Calibration

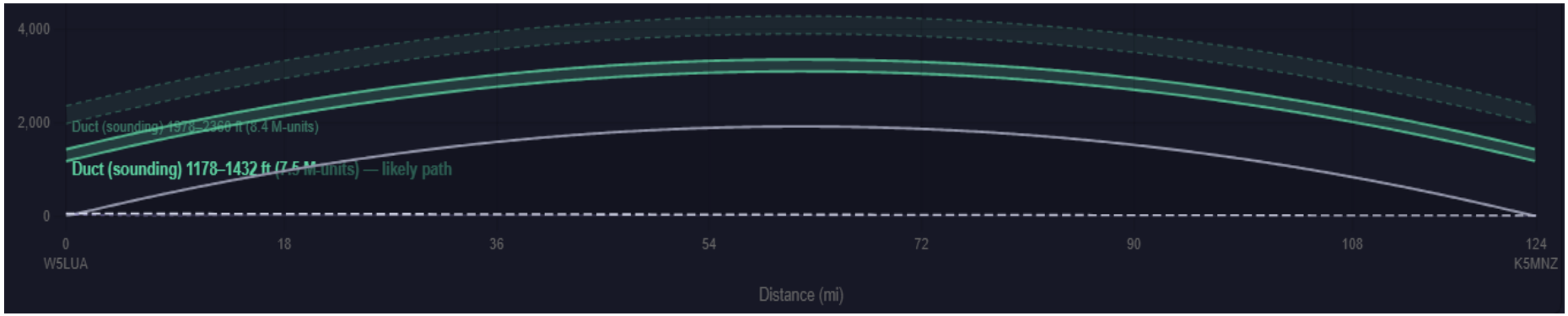
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- All contacts initially & currently scored:
  - **HRRR model profiles** at 3 km / hourly for 2014-present contacts and NARR reanalysis (NCEP, 32 km Lambert / 3-hourly, 1979-01 → 2014-10) for the small pre-HRRR tail
  - **IEMRE gridded hourly observations**, RAOB soundings, NEXRAD n0q composite reflectivity for common-volume radar analysis, and per-QSO terrain path profiles. RTMA (2.5 km, 15-min) supplements real-time surface conditions between HRRR hours.

Meteorological Foundation

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- The primary mechanisms of interest are tropospheric ducting via refractivity gradients and frequency-dependent gaseous/hydrometeor attenuation.



- Duct enabled contact at 10 GHz as rendered by NTMS propagation engine.

Refractivity Framework

- Radio refractivity N (ITU-R P.453-14):
  - $N = 77.6 \cdot P/T + 3.73 \times 10^5 \cdot e/T^2$
  - P (hPa), T (K), e = water vapor pressure (hPa) via Buck equation from Td. The wet term contributes 20–40% of total N in the ABL.
  - Modified refractivity $M = N + 0.157 \cdot h$ (h in m AGL); ducting where $dM/dh < 0$.
  - The vertical gradient dN/dh governs ray curvature via the effective earth radius factor $k = 1/(1 + R \cdot dN/dh \cdot 10^{-6})$:

Refractivity Framework

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DN/DH (N/KM)	K	REGIME
> 0	< 1	Sub-refraction
0 to −79	1.0–2.0	Normal (standard atmosphere: −39, k = 4/3)
−79 to −157	2.0–∞	Super-refraction
< −157	negative	Ducting (ray curvature exceeds earth curvature)

Ducting Mechanisms

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- Four mechanisms produce the negative dN/dh gradients that enable beyond-LOS propagation. Each creates a sharp temperature increase and/or moisture decrease with height:
  - Radiation (Nocturnal) Ducts −100 to −300 N/km
  - Advection Ducts −200 to −500 N/km
  - Subsidence Ducts -100 to −200 N/km
  - Frontal/Boundary Ducts

Frequency-Dependent Attenuation

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- The same thermodynamic state produces opposing propagation effects across the spectrum:
  - 10 GHz: Gaseous attenuation negligible (0.012 dB/km). Propagation governed largely by refractivity structure and forward scatter.
  - 24 GHz: Proximal to the 22.235 GHz H_2O rotational line. H_2O absorption coefficient 0.012 dB/km per g/m³ (10× the 10 GHz rate). Rain attenuation 6× that of 10 GHz.

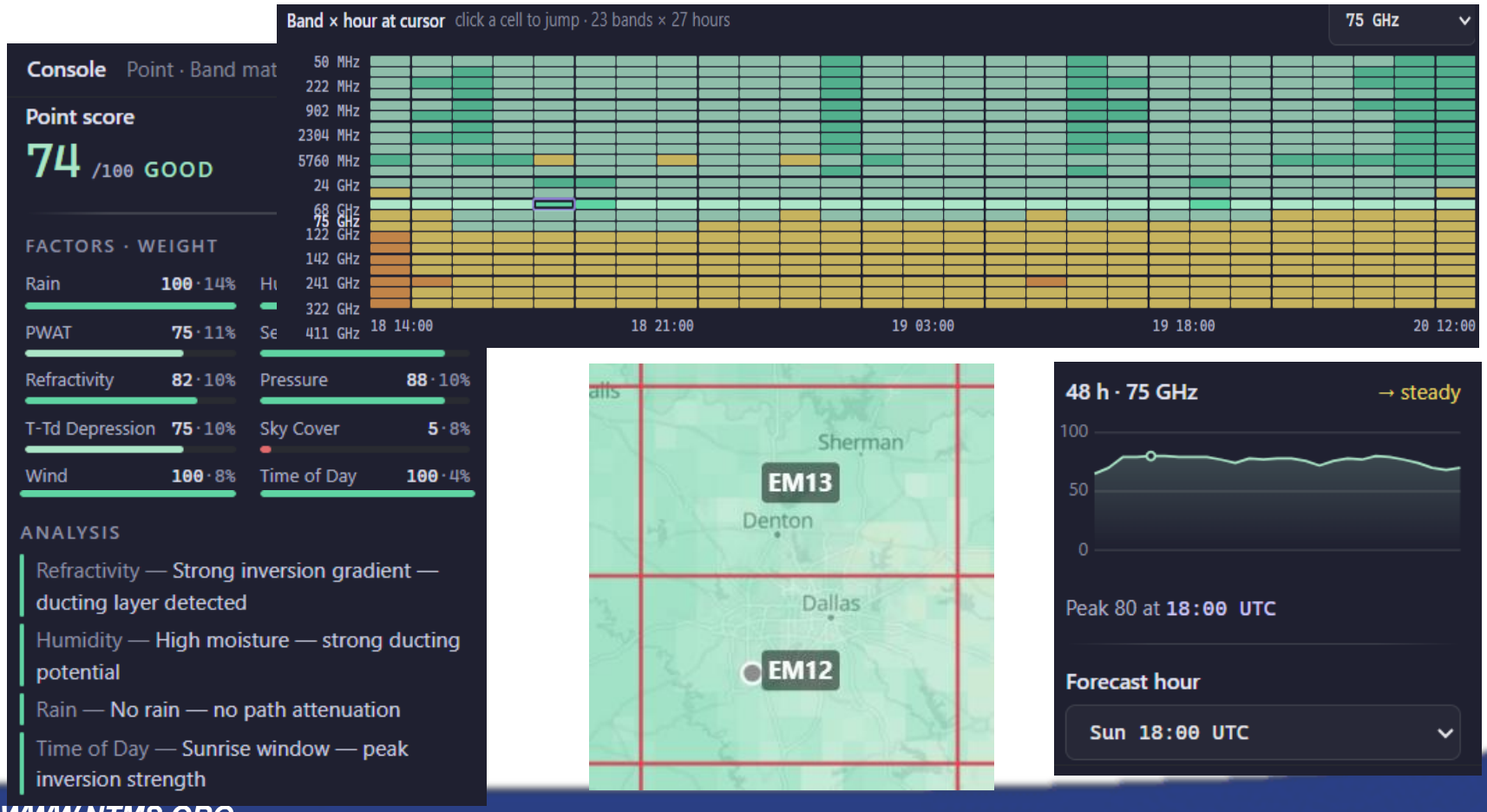
Frequency-Dependent Attenuation

- 47–75 GHz: Transition regime. 47 GHz in a relative window (O_2 wing + mild H_2O).
- 76 GHz in a window band between 60 O_2 and 118/183 GHz H_2O. We used ITU-R P.676.
- 122 GHz on the 118.75 GHz O_2 line wing (0.8 dB/km).
- 134 GHz in the window between O_2 118 and H_2O 183 lines.
- 241 GHz between H_2O 183 and 325 GHz lines (0.3 dB/km per g/m³).

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Prop tools available:Map[1]

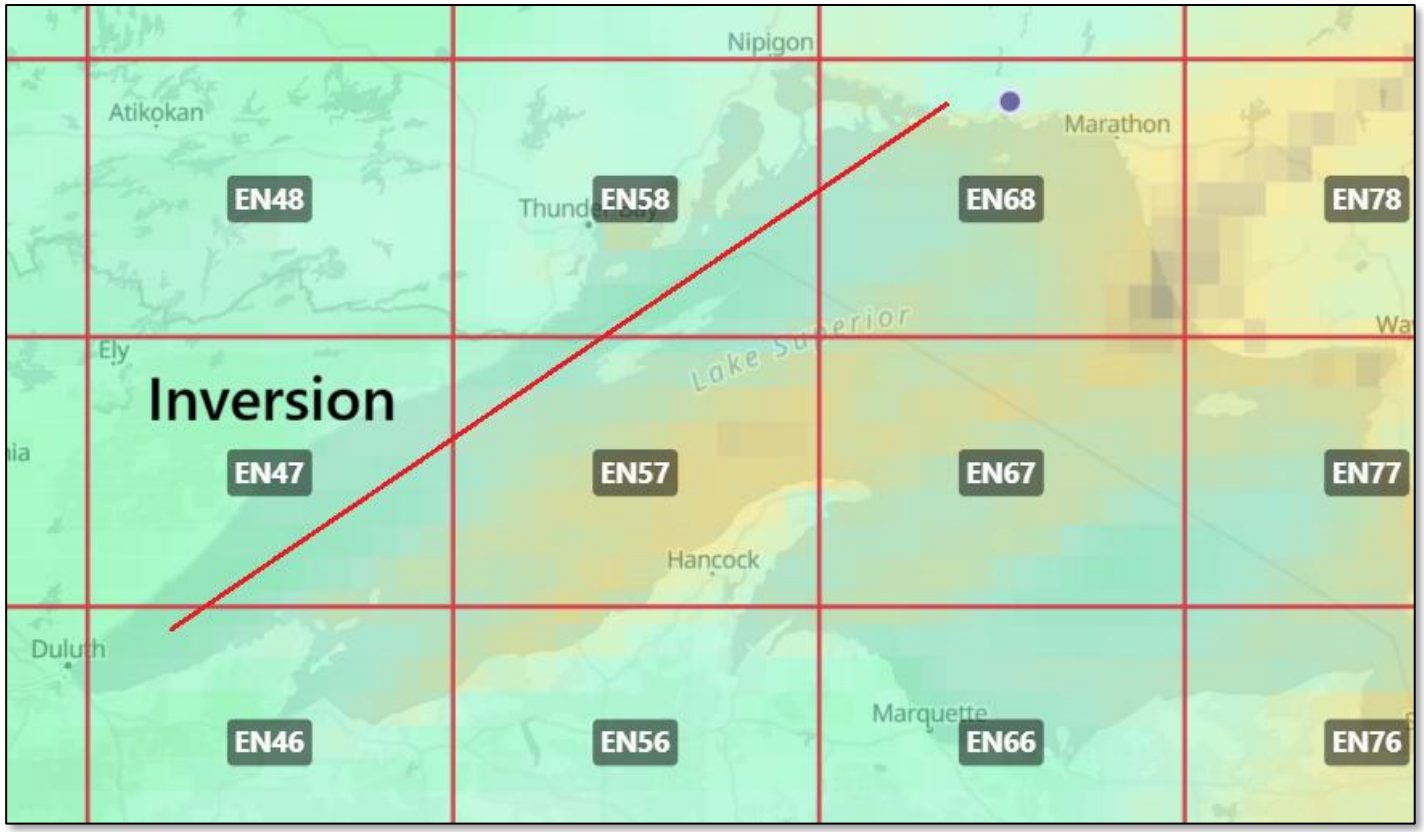
– By band, prop prediction tool



Prop tools available: Weather²

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– Atmospheric metrics by hour



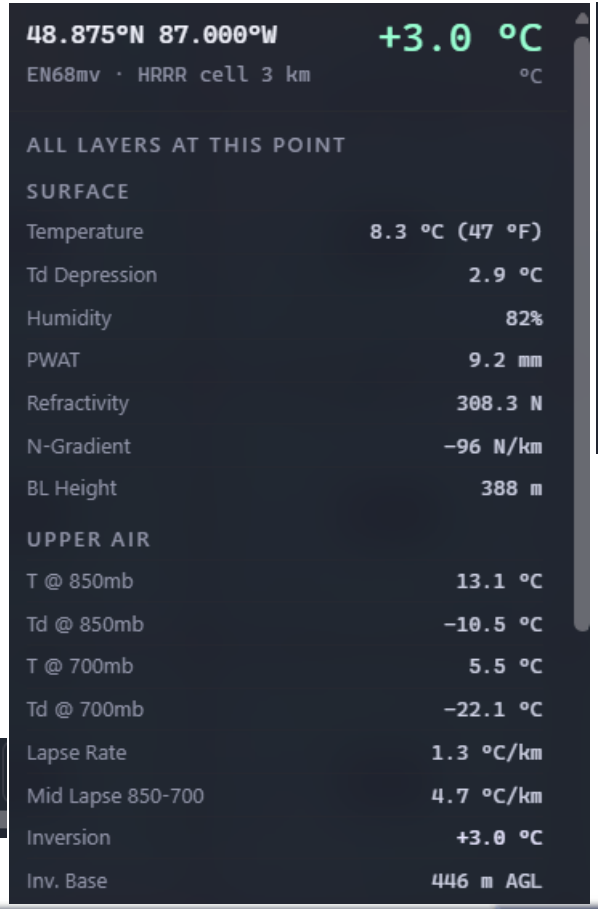


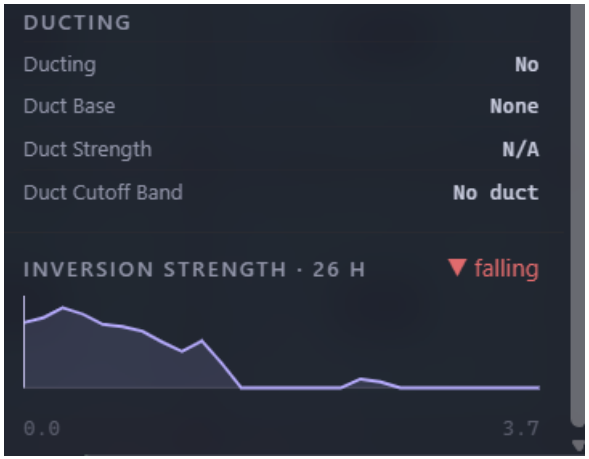
Prop tools available: Weather²

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– Atmospheric metrics by hour

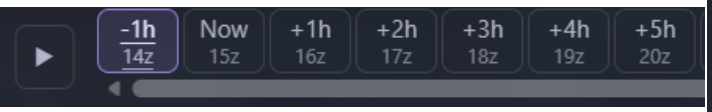






Hour cards

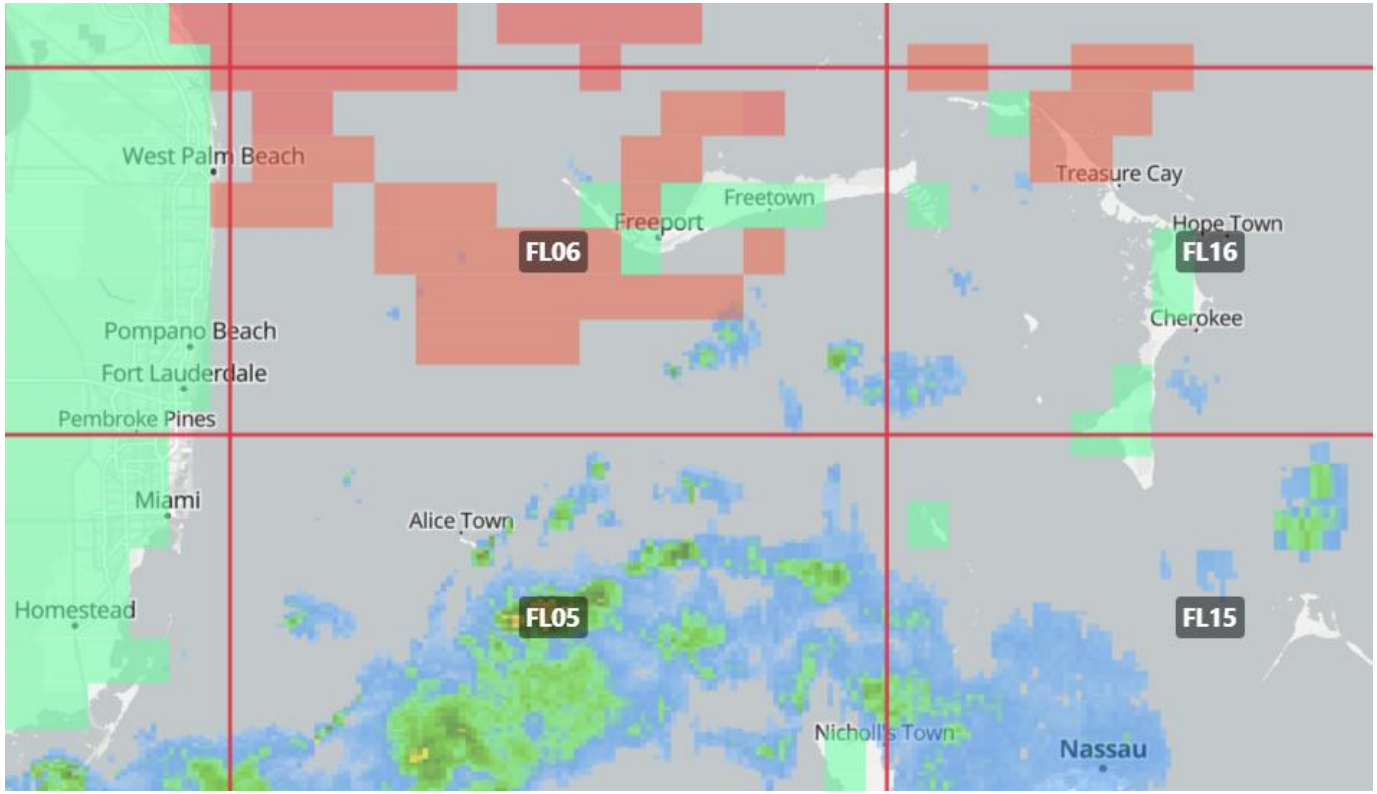
Extend to 48 hrs



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Prop tools available: Weather²

– Turn on radar layer



– Inversion base has been selected

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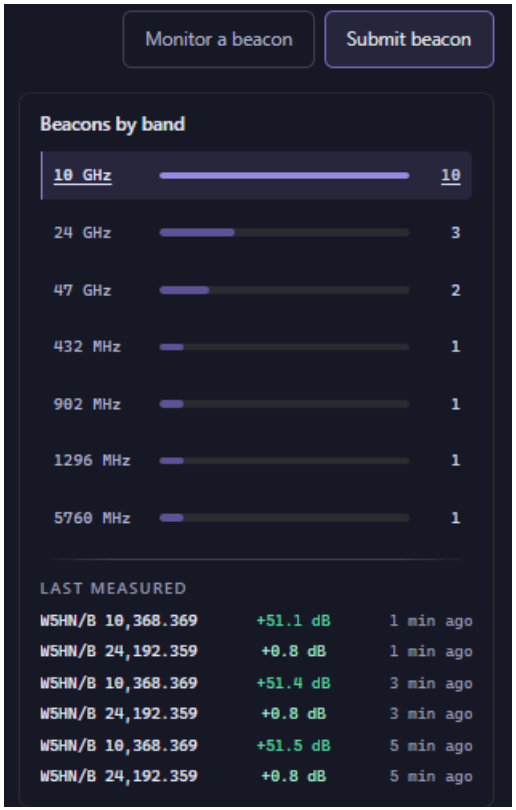
Prop tool: Skew-T-log-P^3



Prop tools available: Beacons[4]

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– First panel for beacons





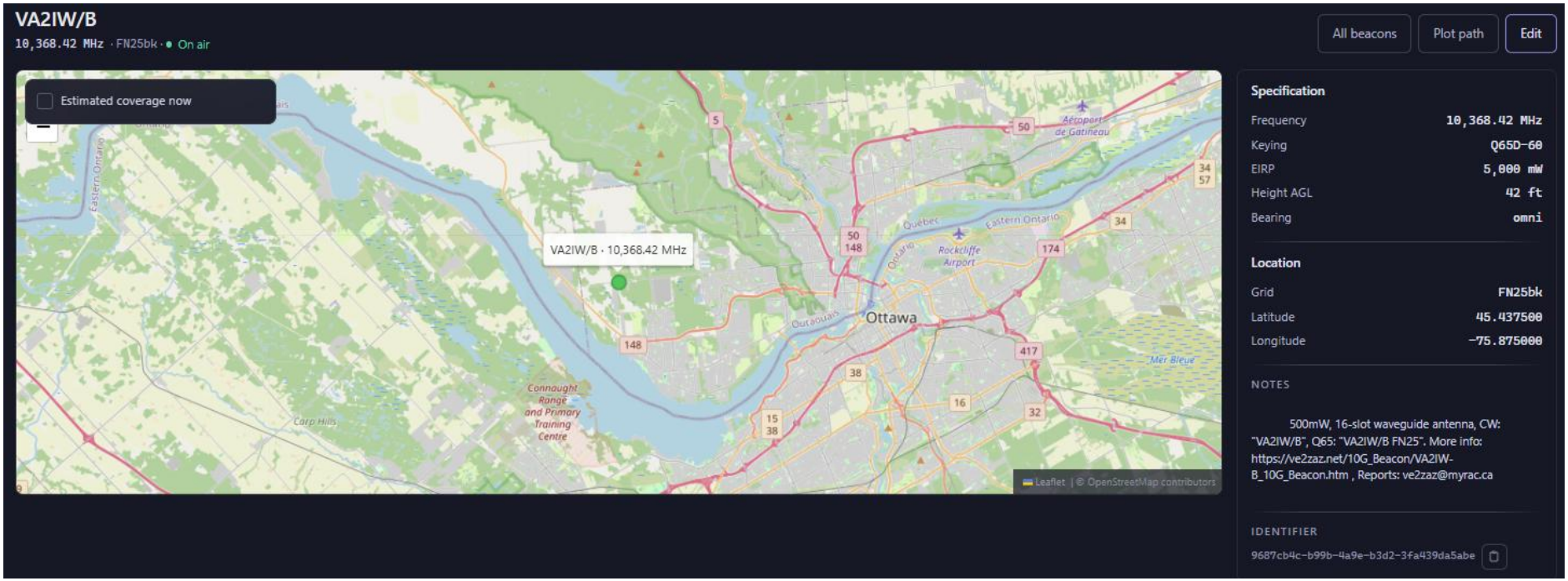
Selecting a band (left) will display beacons on that frequency and the current band conditions

Beacons monitored and reported via API to NTMS

Prop tools available: Beacons[4]

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– Details of the beacon

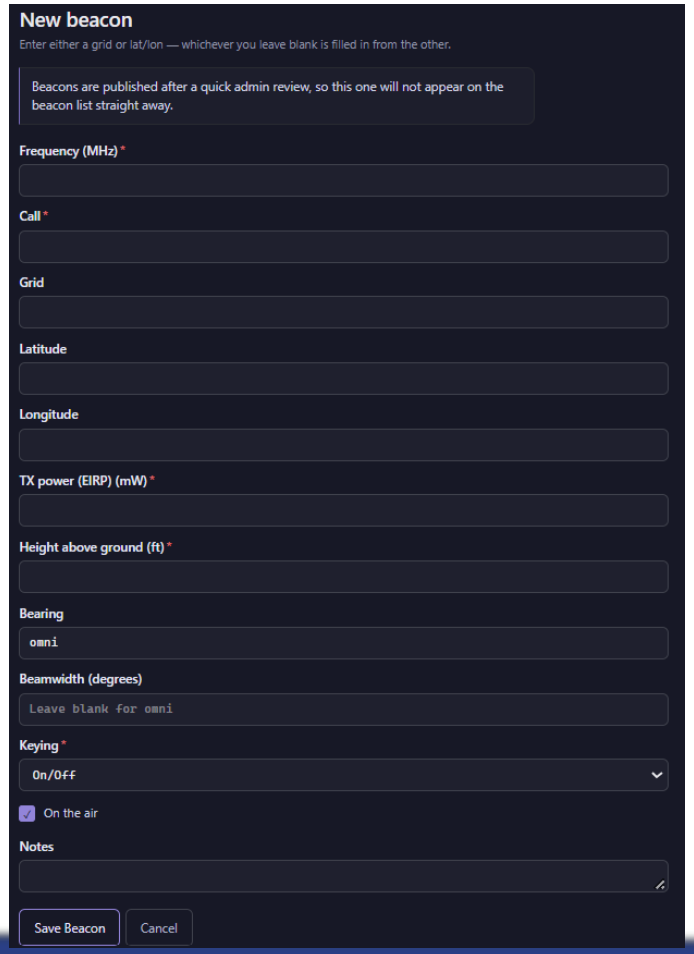


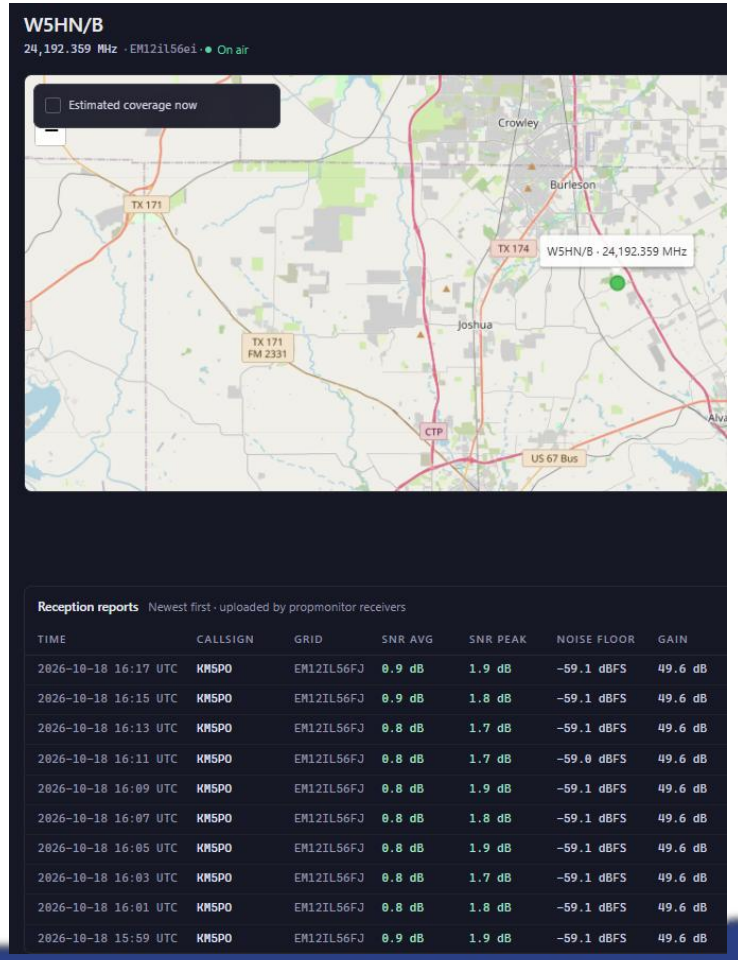
Bert's beacon for 10 GHz (VA2IW/B FN25bk)

Prop tools available: Beacons[4]

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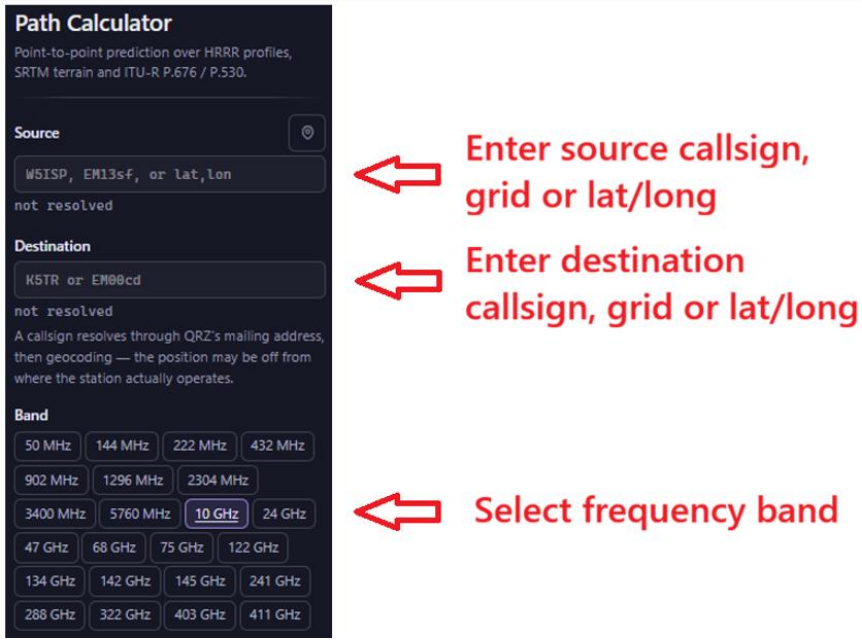
Submit a beacon at this link





Prop tools available: Path[5]

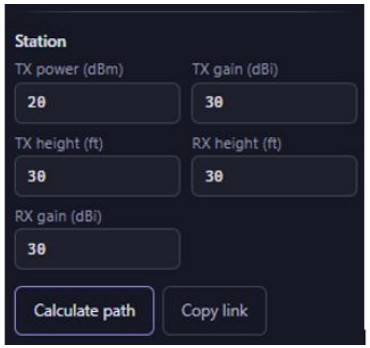
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Enter source callsign, grid or lat/long

Enter destination callsign, grid or lat/long

Select frequency band

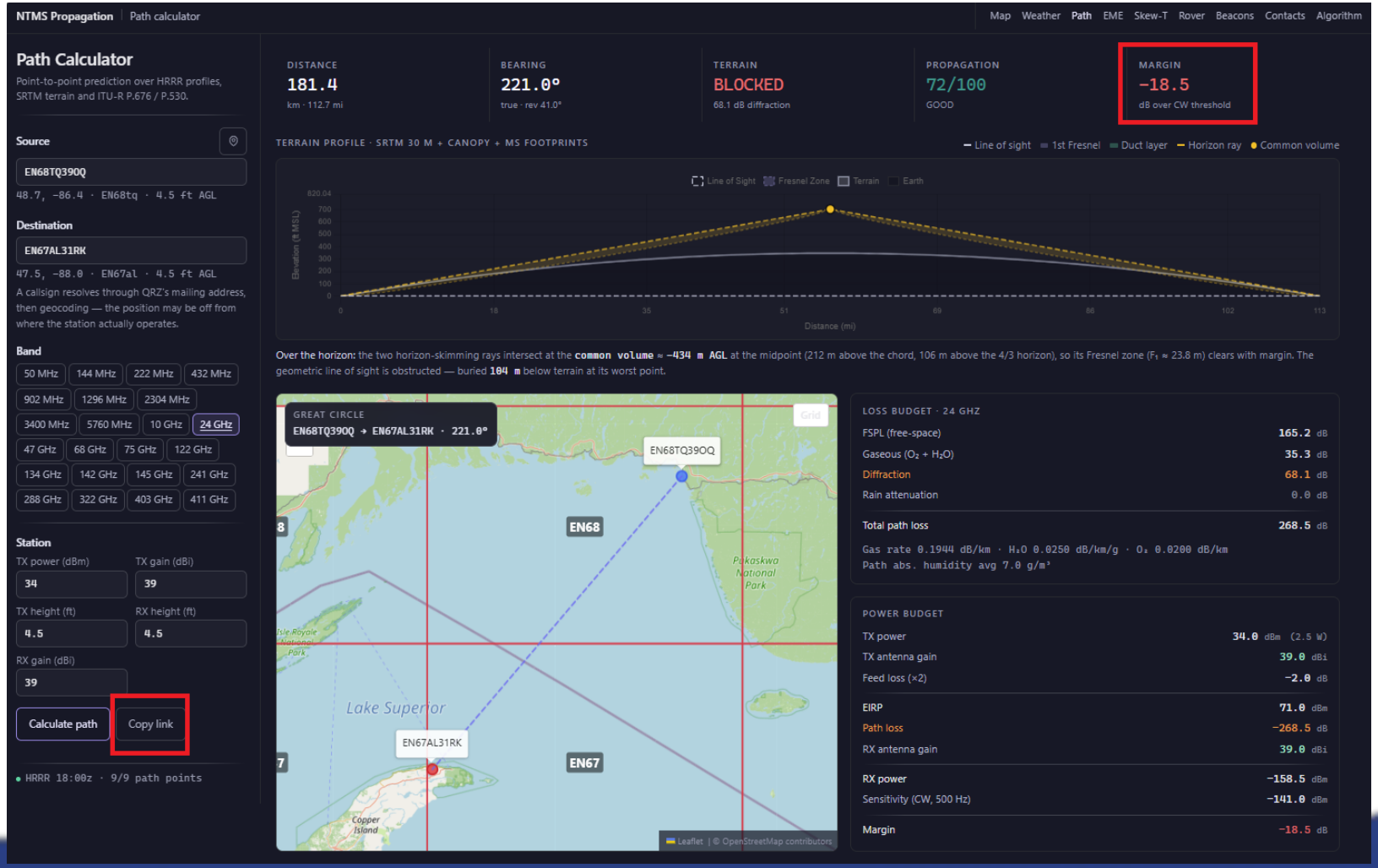


Enter both station's metrics

Click "Calculate path"

Prop tools available: Path[5]

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Path prediction data

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Using the “Copy Link” button

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- The link you copy contains the research parameters:
  - band=24000
  - destination=EN76AQ61FX
  - dst_gain_dbi=39
  - dst_height_ft=4.5
  - source=EN68TQ39OQ
  - src_gain_dbi=39
  - src_height_ft=4.5
  - tx_power_dbm=34

Batch predictions can be processed

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- Multiple .csv files containing parameters:

band	destination	dst_gain_dbi	dst_height	source	src_gain_d	src_height_ft	tx_power_dbm
24000	EM13QC68IL	36	70	EM13PM75AW	39	5	35
24000	EM13QC68IL	36	70	EM13SI53FI	39	5	35

⇦ Single_band_24.csv

band	destination	dst_gain_d	dst_height	source	src_gain_dbi	src_height_ft	tx_power_dbm
47000	EM13QC68IL	36	55	EM13PM75AW	36	5	25
47000	EM13QC68IL	36	40	EM13SI53FI	36	4	25

⇦ Single_band_47.csv

band	destination	dst_gain_dbi	dst_height_ft	source	src_gain_dbi	src_height_ft	tx_power_dbm
75000	EM13QC68IL	36	55	EM13PM75AW	36	5	25
75000	EM13QC68IL	30	55	EM13SI53FI	27	4	25

⇦ SIngle_band_76.csv

band	destination	dst_gain_dbi	dst_height_ft	source	src_gain_dbi	src_height_ft	tx_power_dbm
75000	en81pm46lk	33	10	EN81RJ45BR	33	10	25
75000	en81pm46lk	33	10	EN81VL73PQ	33	10	25
75000	en81pm46lk	33	10	EN91EN30KF	33	10	25
75000	en81pm46lk	33	10	EN91KT00HW	33	10	25
75000	en81pm46lk	33	10	EN91LU41	33	10	25
75000	en81pm46lk	33	10	EN91OV37	33	10	25

⇦ Single_band_76-K8ZR.csv

- Are listed in a “process” file of filenames:

Single_band_24.csv	Single_band_24_accum.csv
Single_band_47.csv	Single_band_47_accum.csv
Single_band_76.csv	Single_band_76_accum.csv
Single_band_76 - K8ZR.csv	Single_band_76-K8ZR_accum.csv

⇦ All four 'SIngle' analysis filenames are placed into a batch driver file named "process_filnames.csv"

Batch predictions can be processed

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- Powershell execution of the ntms_wrapper:

```
PS C:\Users\km5po\q65analysis\parser> python3 ntms_wrapper.py process_filenames_VE4MA.csv --sleep-minutes 10
Running every 10 minute(s). Press Ctrl-C to stop.
```

- For the python types:

```python
# Persistent mode: run forever, sleeping between cycles, until Ctrl-C.
print(f"Running every {args.sleep_minutes:g} minute(s). Press Ctrl-C to stop.\n")
cycle_num = 0
try:
    while True:
        cycle_num += 1
        run_cycle(args, cycle_num)
        print(f"\nSleeping {args.sleep_minutes:g} minute(s) until cycle {cycle_num + 1}... (Ctrl-C to stop)\n")
        time.sleep(args.sleep_minutes * 60)
except KeyboardInterrupt:
    print("\nStopped by user (Ctrl-C). Exiting cleanly.")
    sys.exit(0)
```

- At completion, the “accum” file has all exported data.

Batch predictions can be processed

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- Accumulated prediction data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	timestamp	band	destination	dst_gain_d	dst_height	source	src_gain_d	src_height	tx_power_	distance_k	propagatio	margin	com_vol_n	fspl	gaseous
2300	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN81RJ45BR	33	10	25	19.7	54/100	52.1	7	155.8	21.1
2301	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN81VL73PQ	33	10	25	44.2	54/100	5.6	38	162.9	48.2
2302	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN91EN30KF	33	10	25	89.5	54/100	-51.5	154	169	95.8
2303	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN91KT00HW	33	10	25	132.1	53/100	-101.9	335	172.4	140
2304	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN91LU41	33	10	25	142.7	53/100	-114.7	392	173	151.3
2305	2026-10-01T00:19:11	75000	en81pm46lk	33	10	EN91OV37	33	10	25	163.9	53/100	-138.2	517	174.2	171.9
2306	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN81RJ45BR	33	10	25	19.7	54/100	52.1	7	155.8	21.1
2307	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN81VL73PQ	33	10	25	44.2	53/100	3.8	38	162.9	48.2
2308	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN91EN30KF	33	10	25	89.5	53/100	-55.3	154	169	96
2309	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN91KT00HW	33	10	25	132.1	49/100	-122.1	335	172.4	141
2310	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN91LU41	33	10	25	142.7	49/100	-184.6	392	173	152.1
2311	2026-10-01T00:39:20	75000	en81pm46lk	33	10	EN91OV37	33	10	25	163.9	49/100	-218.2	517	174.2	172.6
2312	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN81RJ45BR	33	10	25	19.7	54/100	52.1	7	155.8	21.1
2313	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN81VL73PQ	33	10	25	44.2	53/100	3.8	38	162.9	48.2
2314	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN91EN30KF	33	10	25	89.5	53/100	-55.3	154	169	96
2315	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN91KT00HW	33	10	25	132.1	49/100	-122.1	335	172.4	141
2316	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN91LU41	33	10	25	142.7	49/100	-184.6	392	173	152.1
2317	2026-10-01T00:59:21	75000	en81pm46lk	33	10	EN91OV37	33	10	25	163.9	52/100	-143.7	517	174.2	170.9

- Evaluations can now take place for as much as you have time to spend on it.



Put the tools to work

- Used strategically for improved scores in the 2026 ARRL 10 GHz and up contestz.
  - Vet new locations prop prediction over time.
    - Compare new locations to well-known locations characterization.
- MAD days – awareness of upcoming great/good/ho-hum conditions. (Roll the truck or not)
- New studies on several sets of terrestrial and over-water paths.
  - Comparison of known, good 47 GHz locations to evaluate 76 GHz characteristics over time.

Graphing results

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NTMS · ROVER LOCATION PROP ANALYSIS

Lake Erie (K8ZR) rover locations

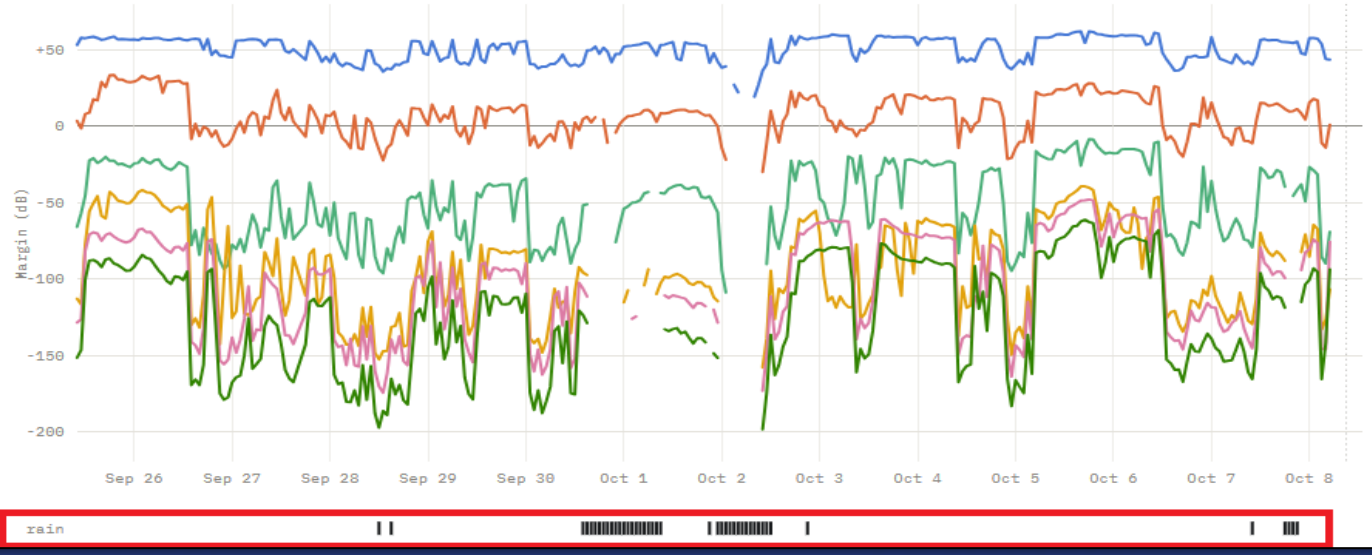
75 GHz band. Hourly-averaged predicted link margin between East Bayshore Drive (EN81PM46LK) and 6 rover locations, Sep 25–Oct 8, 2026. Each 15-minute sample is squashed into its hour before averaging; margins are the predicted values as reported (no offset).

EN81RJ45BR — 19.7 km EN81VL73PQ — 44.2 km EN91EN30KF — 89.5 km EN91KT00HW — 132.1 km
EN91LU41 — 142.7 km EN91OV37 — 163.9 km

Chart Table

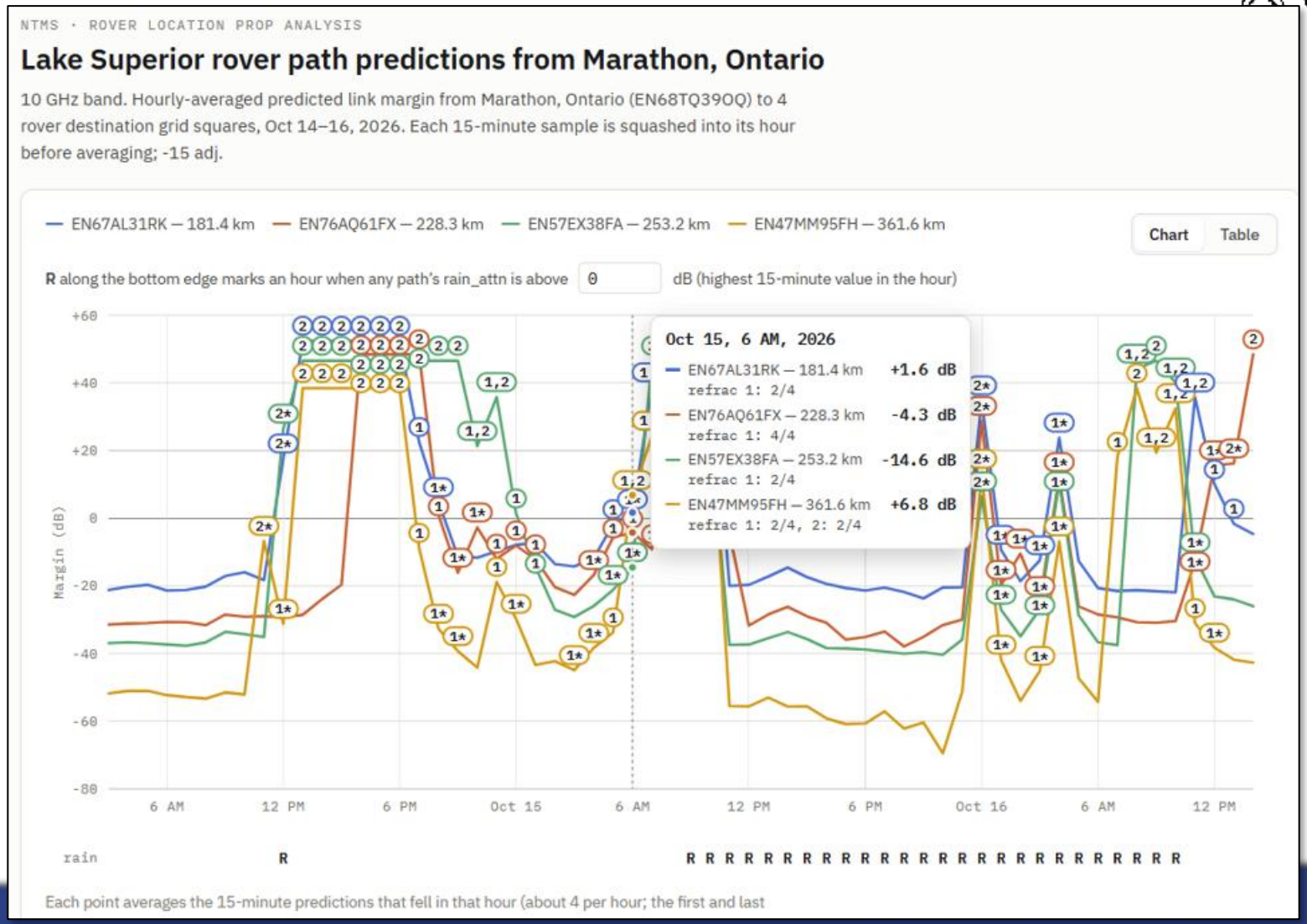
Hide a path's hour when its rain_attn is above 20 dB (highest 15-minute value in the hour)

R along the bottom edge marks an hour when any path's rain_attn is above 0 dB (highest 15-minute value in the hour)



Graphing results

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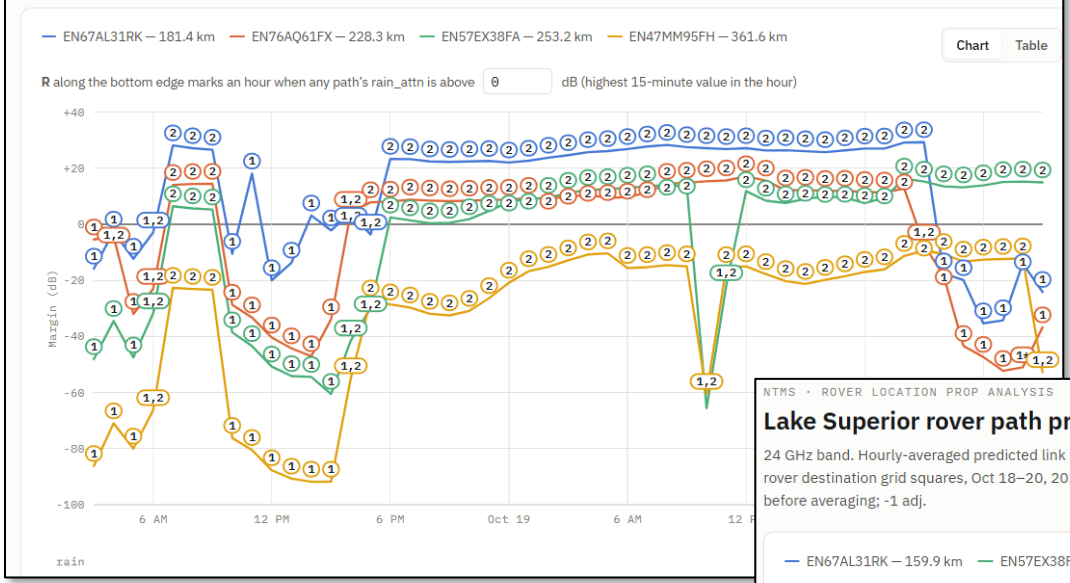
Graphing results

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NTMS · ROVER LOCATION PROP ANALYSIS

Lake Superior rover path predictions from Marathon, Ontario

24 GHz band. Hourly-averaged predicted link margin from Marathon, Ontario (EN68TQ39OQ) to 4 rover destination grid squares, Oct 18–20, 2026. Each 15-minute sample is squashed into its hour before averaging; -1 adj.

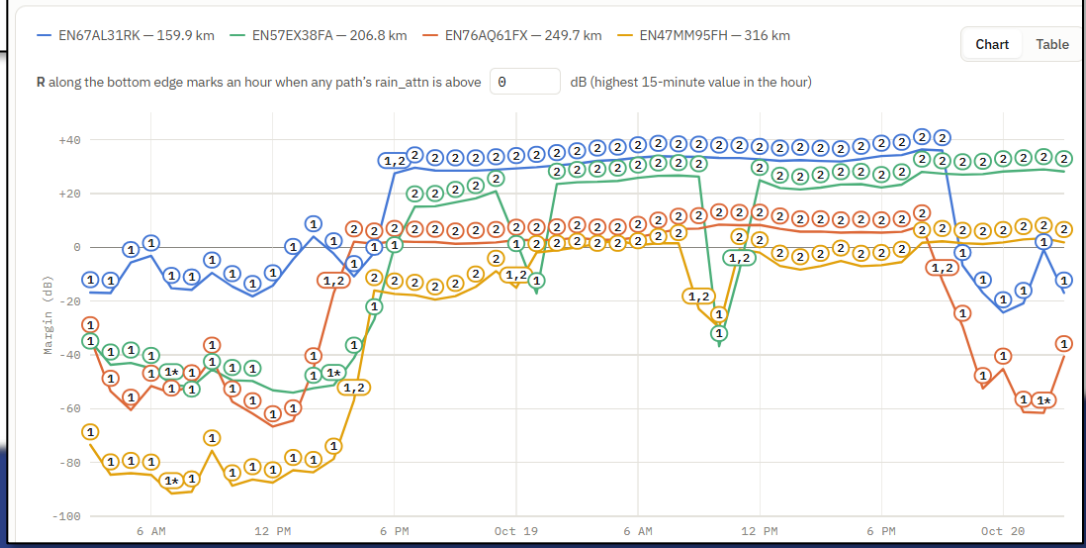




NTMS · ROVER LOCATION PROP ANALYSIS

Lake Superior rover path predictions from Terrace Bay, Ontario

24 GHz band. Hourly-averaged predicted link margin from Terrace Bay, Ontario (EN68KS77MN) to 4 rover destination grid squares, Oct 18–20, 2026. Each 15-minute sample is squashed into its hour before averaging; -1 adj.



And then there is rain scatter

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W5LUA - AI - EM13qc68il 7:40 PM
Looks like RS on 10G EM12il beacon

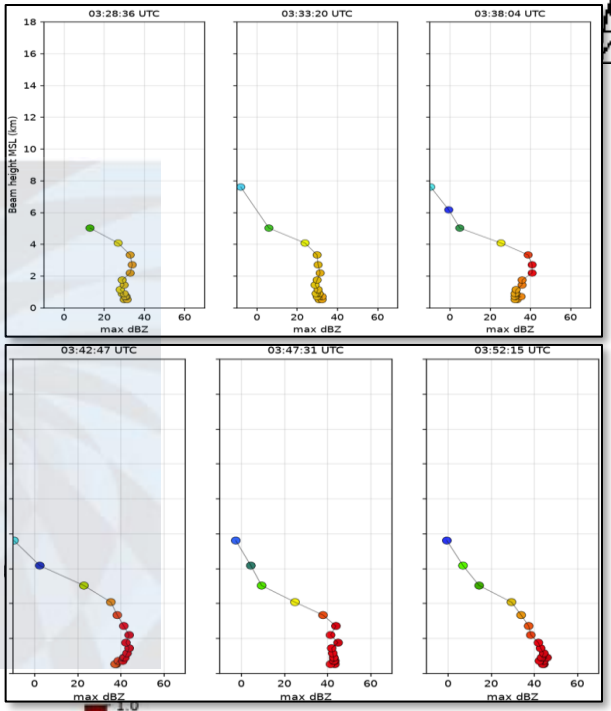
appears to be too much spreading for a Q65-60D decode

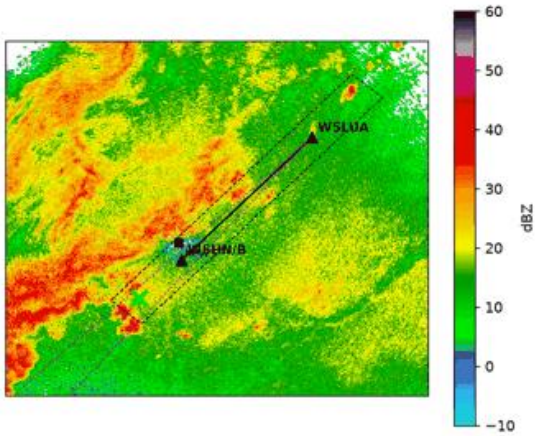
0046 -9 0.2 1526 : W5HN/B EM12IL q0
0046 -9 0.2 1525 : W5HN/B EM12IL q0
0046 -9 0.2 1525 : W5HN/B EM12IL q0
0048 -10 0.5 1520 : W5HN/B EM12IL q0

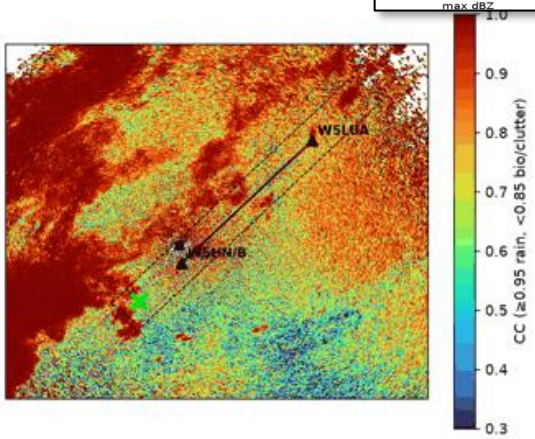
300 Hz of doppler and decodes

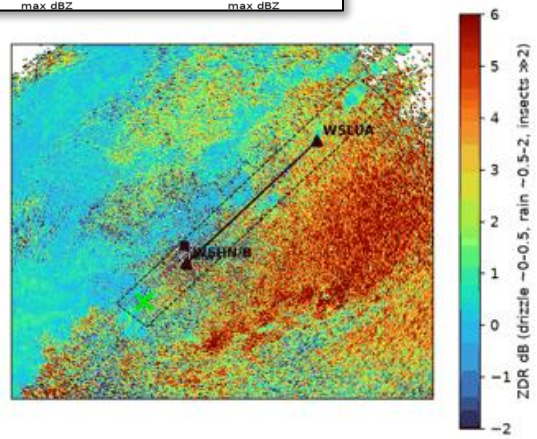
W5LUA - AI - EM13qc68il 7:55 PM
even greater doppler

0052 -6 0.5 1727 : W5HN/B EM12IL q0
0054 -3 0.5 1651 : W5HN/B EM12IL q0



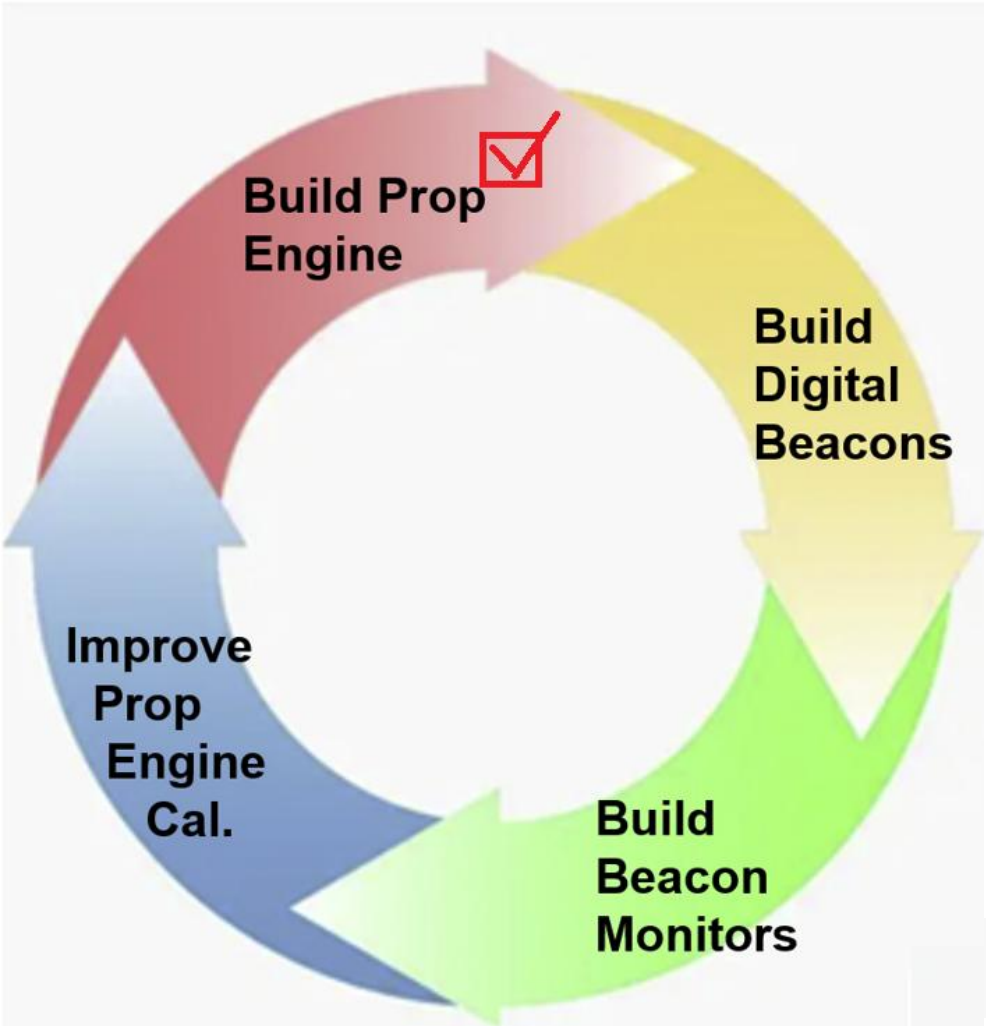






Accomplished so far

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Beacon builds

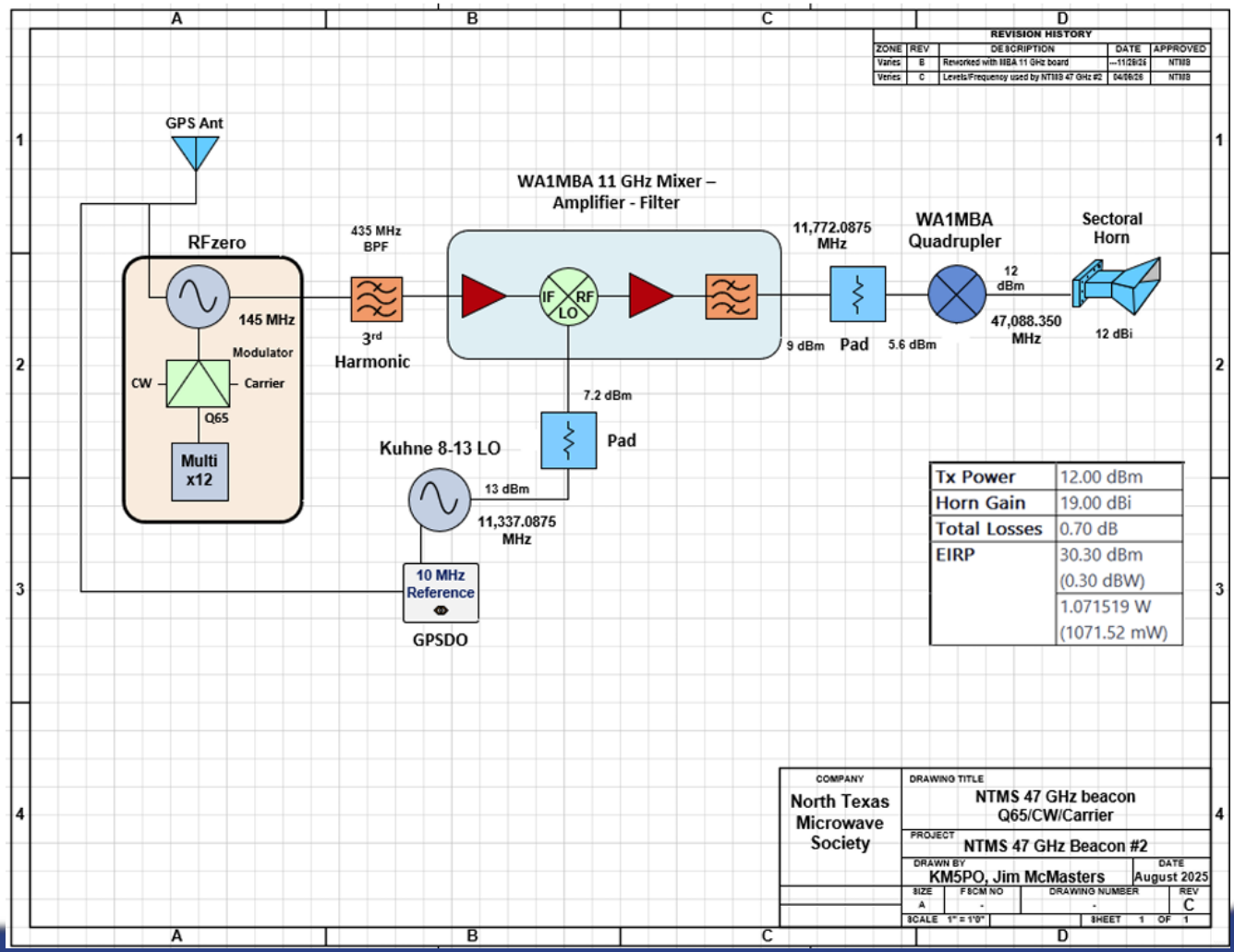
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- NTMS 10/24/47 GHz beacon with CW/Carrier and Q65D-60 modulation[7]
- Standalone 47 GHz beacon with CW/Carrier and Q65D-60 modulation[8]

Call	Freq MHz	Power	Antenna	Gain	Grid
W5HN/B	10368.369	3 w	Slot – 40 total	15 dBi	EM12IL56EI
W5HN/B	24192.369	3 w	6” Horn/Lens	20 dBi	EM12IL56EI
W5HN/B	47088.369	10 dBm	Conical Horn	19 dBi	EM12IL56EI
W5LUA/B	47088.363	10 dBm	Sectoral Horn	14.5 dBi	EM13SF89TA

Example beacon (47 GHz)

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Example beacon (47 GHz)



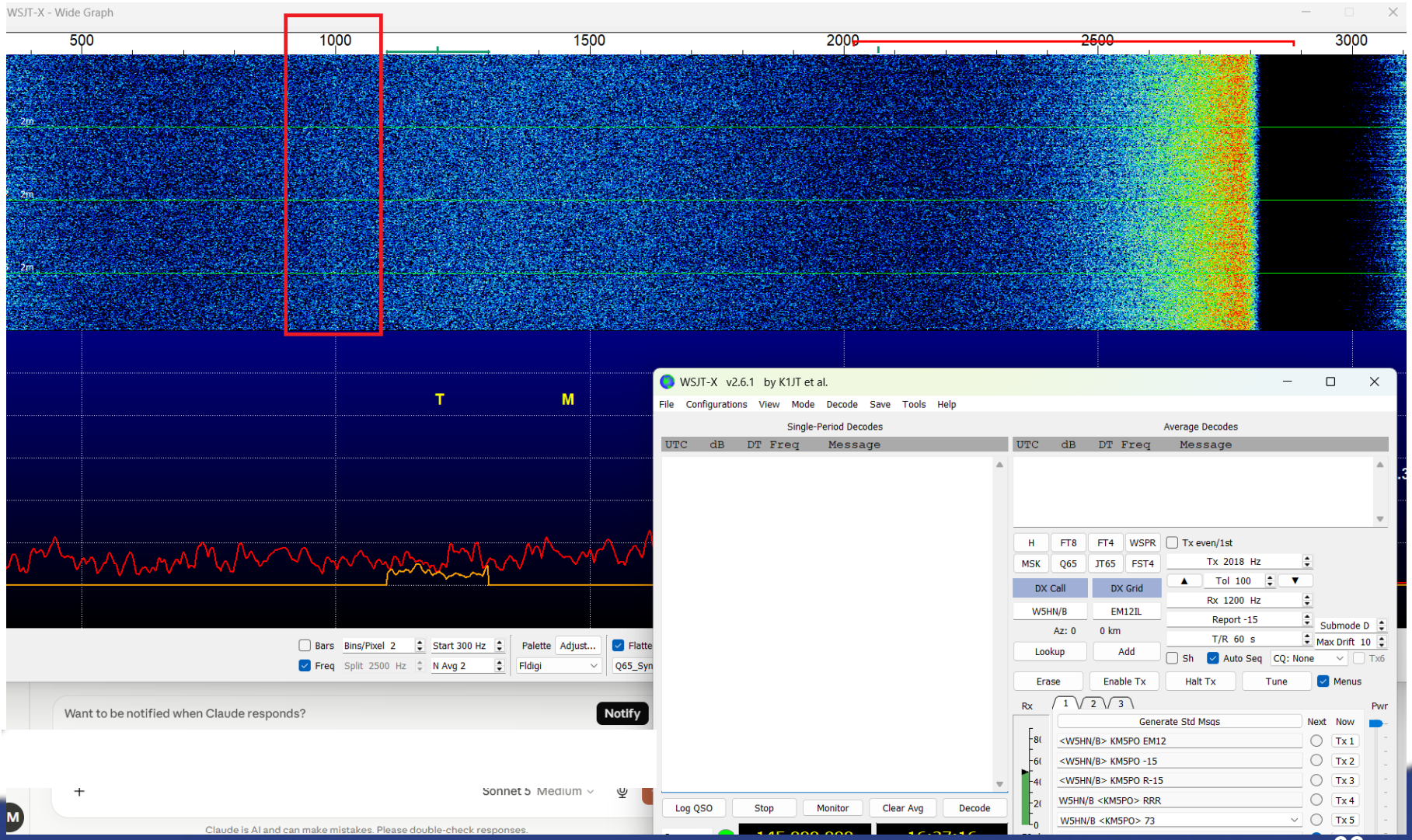
NTMS Q65-60D beacons

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- Even minute modulates digital Q65 for 52 seconds. Sync tone = 1200 Hz when mode is SSB data.
- Odd minute: CW ID then remainder of minute is carrier at 1200 Hz.
- Odd minute carrier can be seen as a faint trace when decodes are approx. 2 dB took weak for decoding.

CW/Carrier but no Q65 decode

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Observations begin

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- Several fixed stations have provided beacon reporting including first-of-a-kind WSJT-X Q65-60D SNR decode data. *When combined with propagation analysis, this becomes an important tool in amateur microwave propagation studies*.
- Case studies[6] became possible June 2026.
  - Urban vs. Rural simultaneous jitter study
  - Urban vs. Rural - two different atmospheres
  - 24 GHz tied to dew point.
  - Parallel 10 and 24 GHz analysis over near-same 100 km urban paths displaying refraction + effects from dew point.
  - Al Ward

Q65-60D successful decodes

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- W5LUA 10 & 24 GHz
- WB5ZDP 10 GHz
- K5MNZ 10 GHz
- K5DOG 10 GHz
- DX:
- W5LUA 95 km
- WB5ZDP 99 km
- K5MNZ 106 km
- K5DOG 254 km



Beacon decode limit is approximately -27 / -28

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Beacon message cannot enter the AP pipeline

Basic parameters of Q65 for each of the five T/R sequence lengths and their minimum tone spacings ("A" submodes) are summarized in the table below. Threshold sensitivities (SNR in 2500 Hz bandwidth yielding 50% probability of decode) were measured for each submode using simulations over the additive white Gaussian noise (AWGN) channel. As with other recently developed modes in *WSJT-X*, a feature called *a priori* (AP) decoding improves sensitivity by several additional dB as information is accumulated during a standard minimal QSO.

50% decode probability

T/R Period (s)	Symbol Length (s)	"A" Tone Spacing (Hz)	"A" Occupied Bandwidth (Hz)	Transmission Duration (s)	SNR (dB)	Max AP SNR (dB)
15	0.150	6.667	433	12.8	-22.2	-23.7
30	0.300	3.333	217	25.5	-24.8	-26.6
60	0.600	1.667	108	51.0	-27.6	-30.2
120	1.333	0.750	49	113.3	-30.8	-32.5
300	3.456	0.289	19	293.8	-33.8	-37.4

Ordinary noise floor improvements

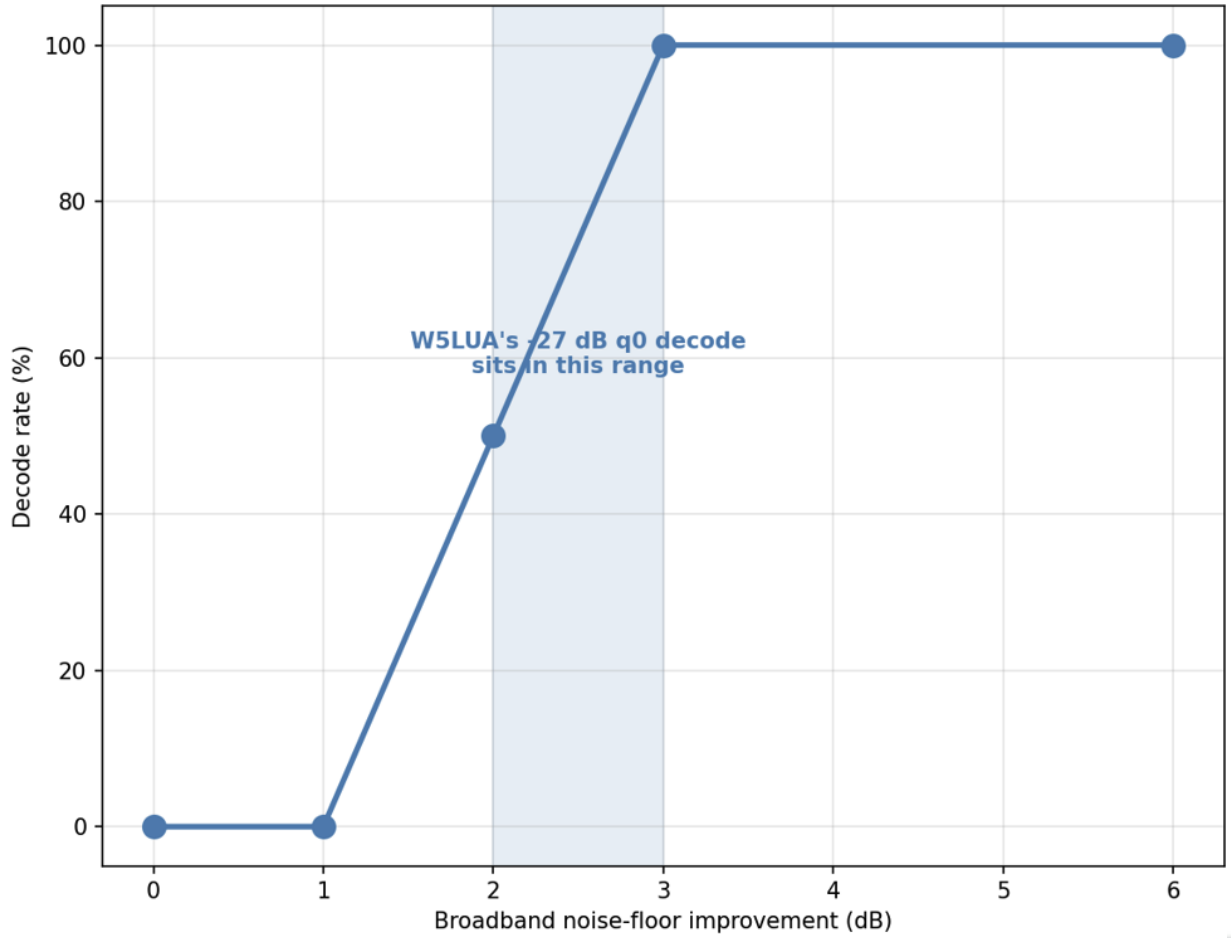
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	0	1	2	3	6	10	14
-26 dB	–	50%	100%	100%	100%	100%	100%
-27 dB	0%	0%	50%	100%	100%	100%	100%
-28 dB	0%	0%	0%	50%	100%	100%	100%
-29 dB	0%	0%	0%	0%	0%	0%	0%
-30 dB	0%	0%	0%	0%	0%	0%	0%

Broadband noise dip depth (dB) →

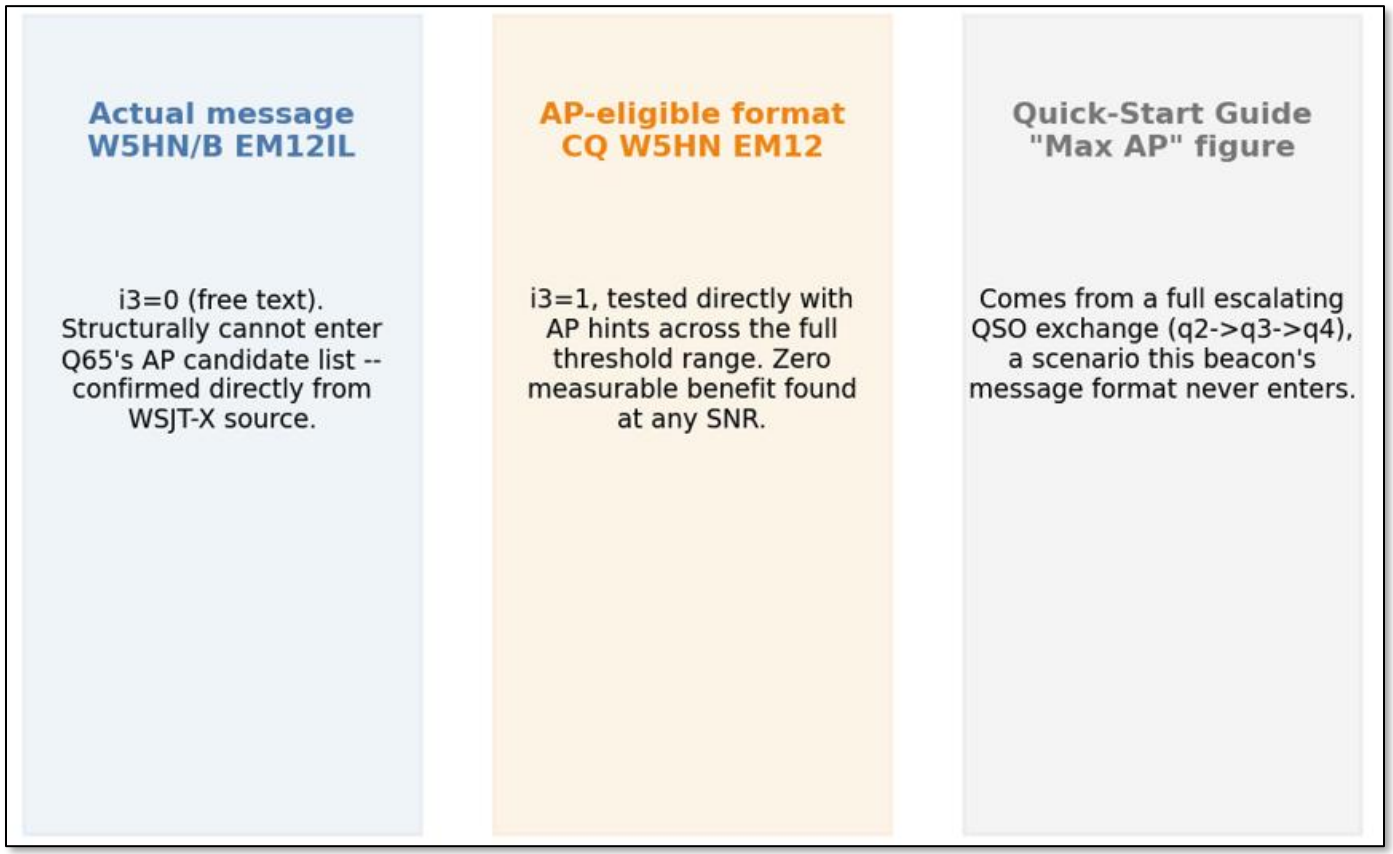
A 2 dB improvement makes possible a -27 dB decode

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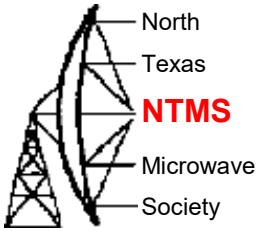


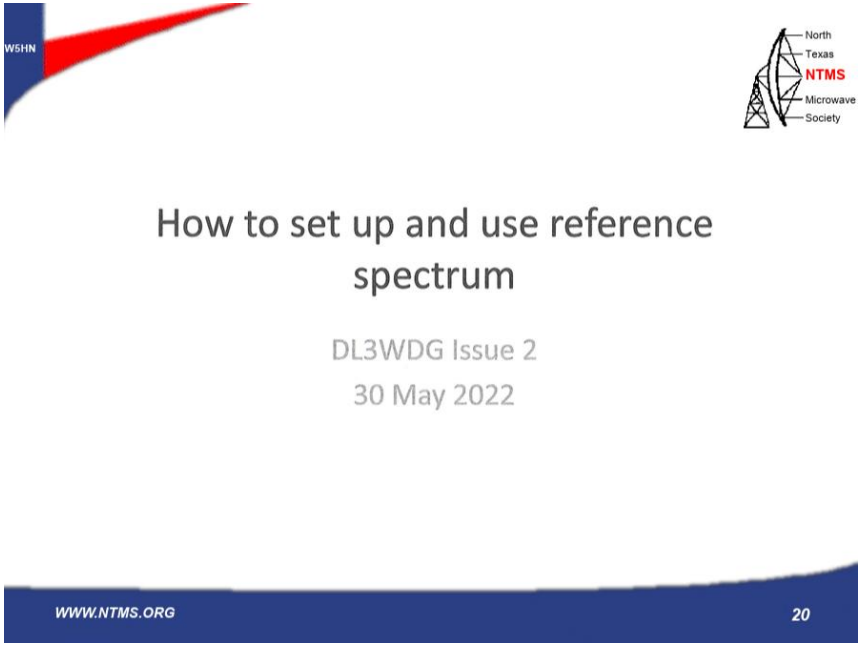
Why “AP adds ~3 dB” does not apply here

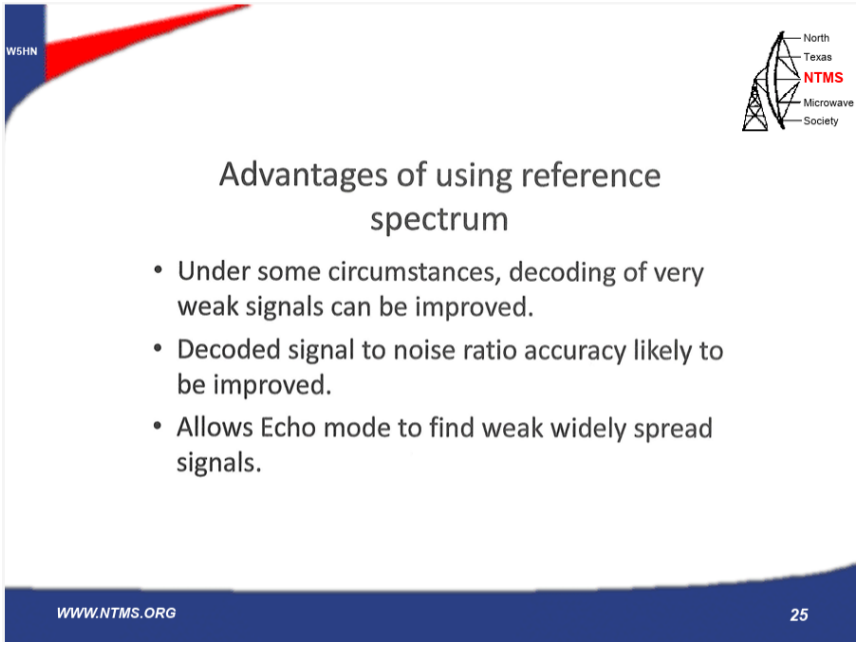
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Tuning your RX system







W5LUA presentation:
https://ntms.org/files/July2026/W5HN_BCN_EM12il_July2026_RevA.pdf

Now we understand

- Rfzero modulation = see the CW/Carrier signal before decodes occur. +2.1 dB SNR
- Better understanding of the decode threshold.
- Lab tools created:
  - Q65 Toolkit – Creates synthetic Q65 files
  - Q65 Analysis – Performs analysis on wav files

Q65Toolkit

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- Runs under Ubuntu (Linux).
- Generates synthetic WSJT-X Q65 .wav files

q65_synth.py

C: › Users › km5po › Downloads › q65_synth.py

```
31  Q65 TIMING (confirmed against WSJT-X source, lib/qra/q65 and map65/libm65):
35      - Tone spacing depends on submode: dfgen = 2**(mode65-1) * 12000/7200 Hz
40          mode65=5 -> E -> 26.67 Hz
41      - Tone for symbol j: f = f0 + itone(j)*dfgen, itone in [0,64].
42        itone==0 marks a sync symbol (transmitted exactly at f0).
43
44  Usage:
45      python3 q65_synth.py "W5HN/B EM12IL" --submode D --snr -18 \
46          --f0 1200 --out beacon_test.wav
47
48      # Batch-generate a set spanning a range of SNRs for calibration:
49      python3 q65_synth.py "W5HN/B EM12IL" --submode C --snr-sweep -30 -10 5 \
50          --out-dir calibration_set/
51
52      # With channel impairments -- accelerating drift, spreading that
53      # changes twice, and a slowly-fading signal:
54      python3 q65_synth.py "W5HN/B EM12IL" --submode D --snr -14 \
55          --drift-start 0.01 --drift-end 0.05 \
56          --spread-min 2 --spread-max 8 --spread-changes 2 \
57          --fade-mode varying --fade-range-db 6 --fade-timescale 5 \
58          --out spread_test.wav
59
60  See q65_channel.py for the full design rationale and caveats on the
61  drift/spread/fade models.
```

Q65Analysis

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- Runs under Windows.
- Batch .wav file processor
- Deep_dig .wav file processor

q65_deep_dig.py

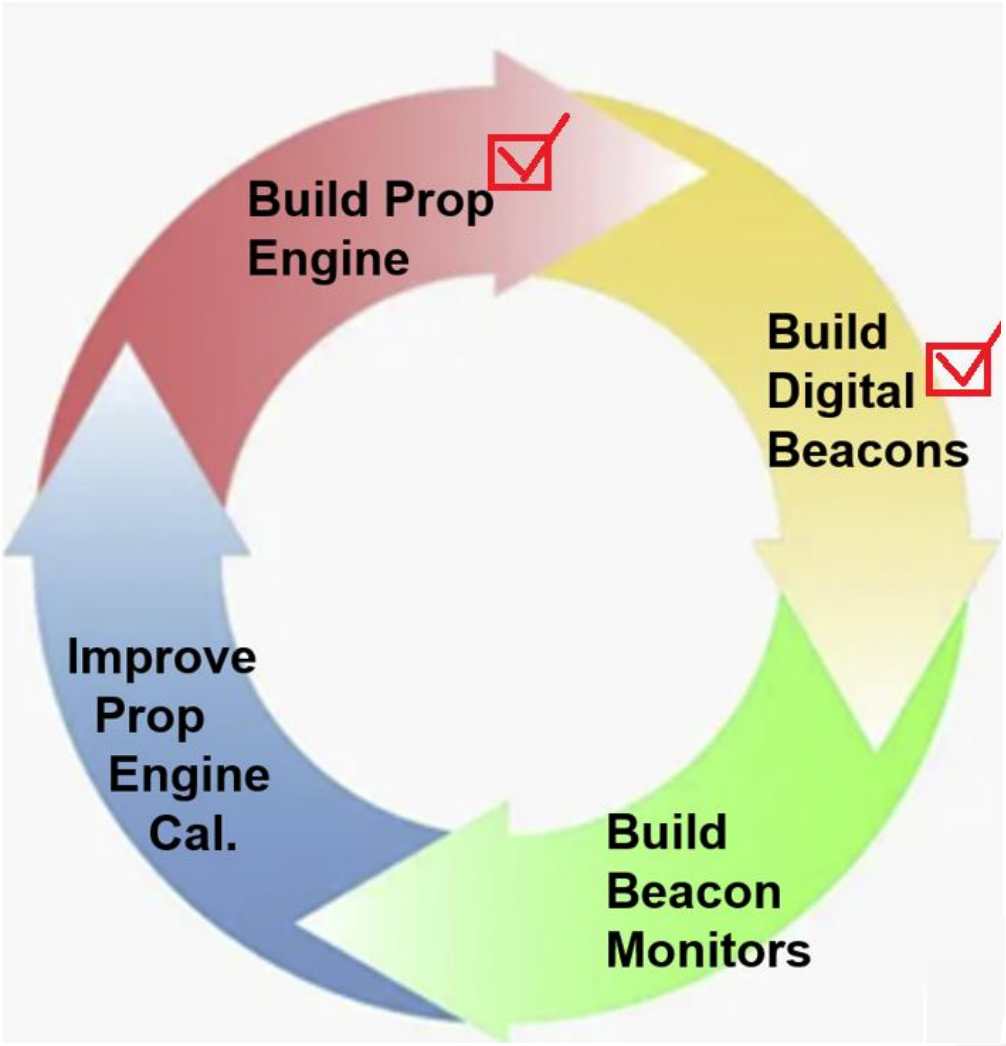
C:\Users\km5po\q65analysis\q65_deep_dig.py

```
#!/usr/bin/env python3
r"""
q65_deep_dig.py
---------------
Deep analysis of marginal/sub-threshold Q65 recordings:
  1. Blind decode (jt9, no AP hints)
  2. AP-assisted decode (jt9, with expected callsign/grid supplied as hints)
  3. Sync-correlation curve extraction (red.dat) regardless of decode outcome,
     so we get a quantitative "was there a sync tone" answer even on total
     decode failures.
  4. Cross-file stacking of the sync curves (since a GPS-locked beacon won't
     drift file-to-file, incoherent averaging across the whole series adds
     real integration gain).

IMPORTANT jt9 quirk this script works around: red.dat/decoded.txt/avemsg.txt
are written to the *temp-path* (-t), which defaults to the current working
directory -- NOT the data-path (-a). If you run jt9 repeatedly from the same
cwd without isolating each run, later runs silently clobber earlier runs'
red.dat. This script runs every jt9 invocation in its own temp directory.

Usage:
    python3 q65_deep_dig.py /path/to/wavs --submode D --period 60 \
        --his-call "W5HN/B" --his-grid "EM12IL" --out-dir results/
```

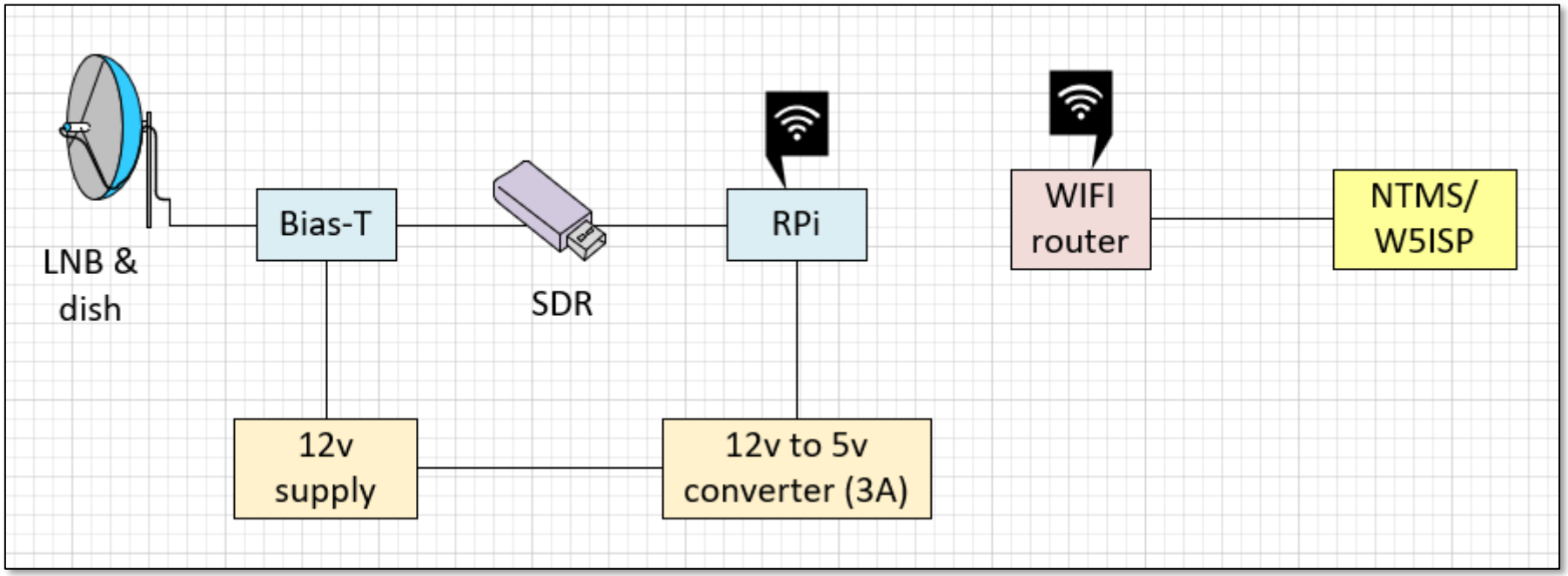
Accomplished so far



Beacon Monitor – 10 GHz

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- Model #1, indoor & outdoor version



Beacon Monitor – 10 GHz BOM

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- Model #1, indoor & outdoor version, LNB IF = 618 MHz

Part	Description	Cost USD
Dish	Surplus	0
LNB	FTA Universal Ku Band LNB 0.1 dB Model 300101	< $10
Bias-T	Needs to pass 12v to LNB and IF freq. of ~618 MHz	< $17 or build
SDR	NooElec NESDR Smart V5 or RTL-SDR	$45
Processor	Raspberry Pi 4 B 2 GB	$50-$95
DC conv.	DC to DC converter to drop 12 v to 5v @ 3 A	< $10 or build
Coax/cable	Various short SMA male to SMA male coax and DC wiring	Approx $5
Software	Available on GitHub public repo: NTMS https://github.com/North-Texas-Microwave-Society/SDR-based-beacon-receive-systems	

Model #1 -10 GHz Monitor

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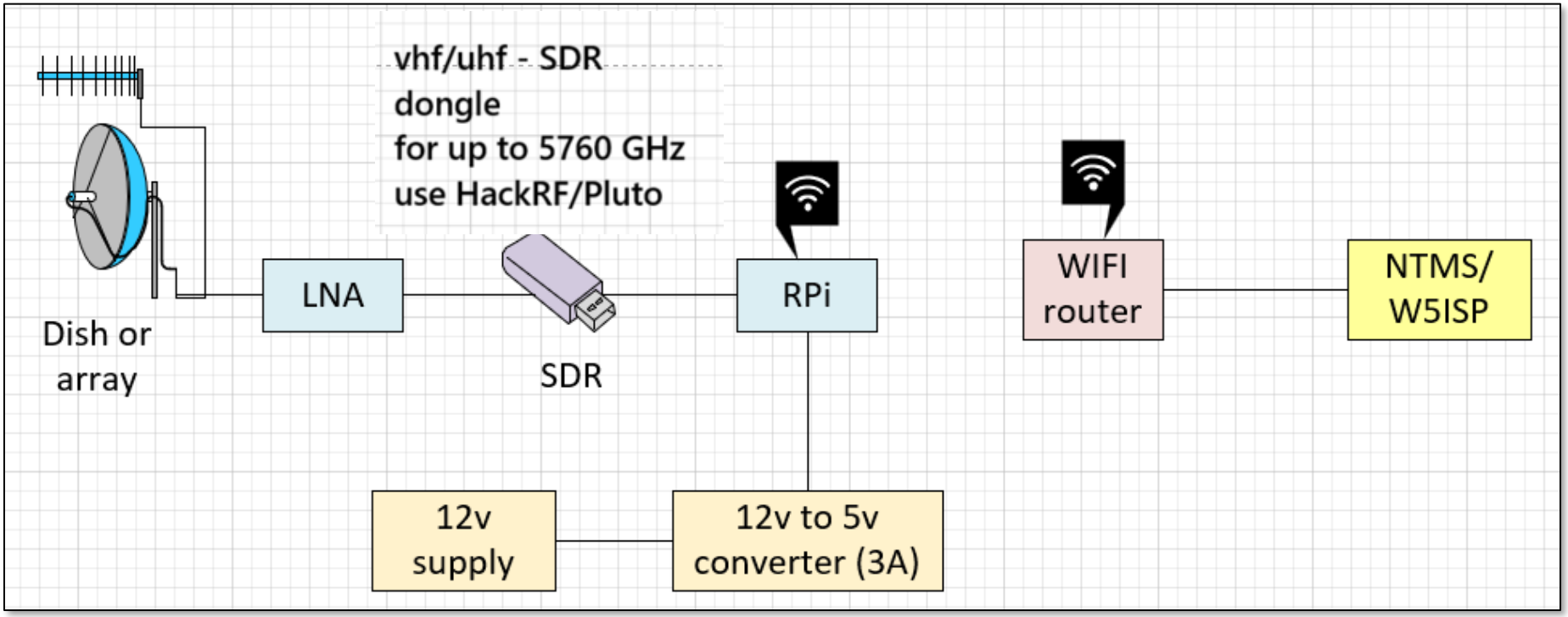




Monitor Designs

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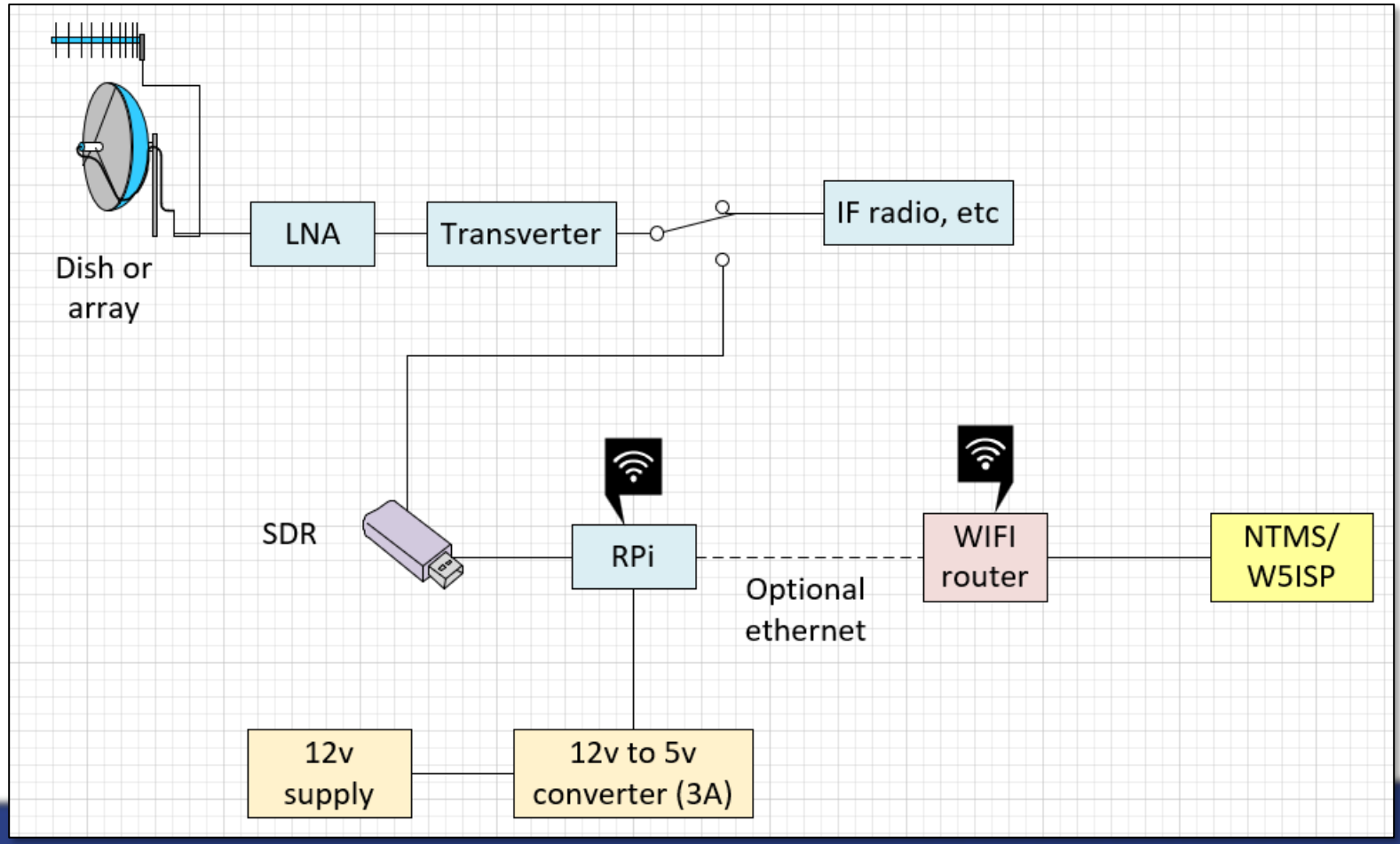
- Model #2, for bands < 10 GHz change wording



Monitor Designs

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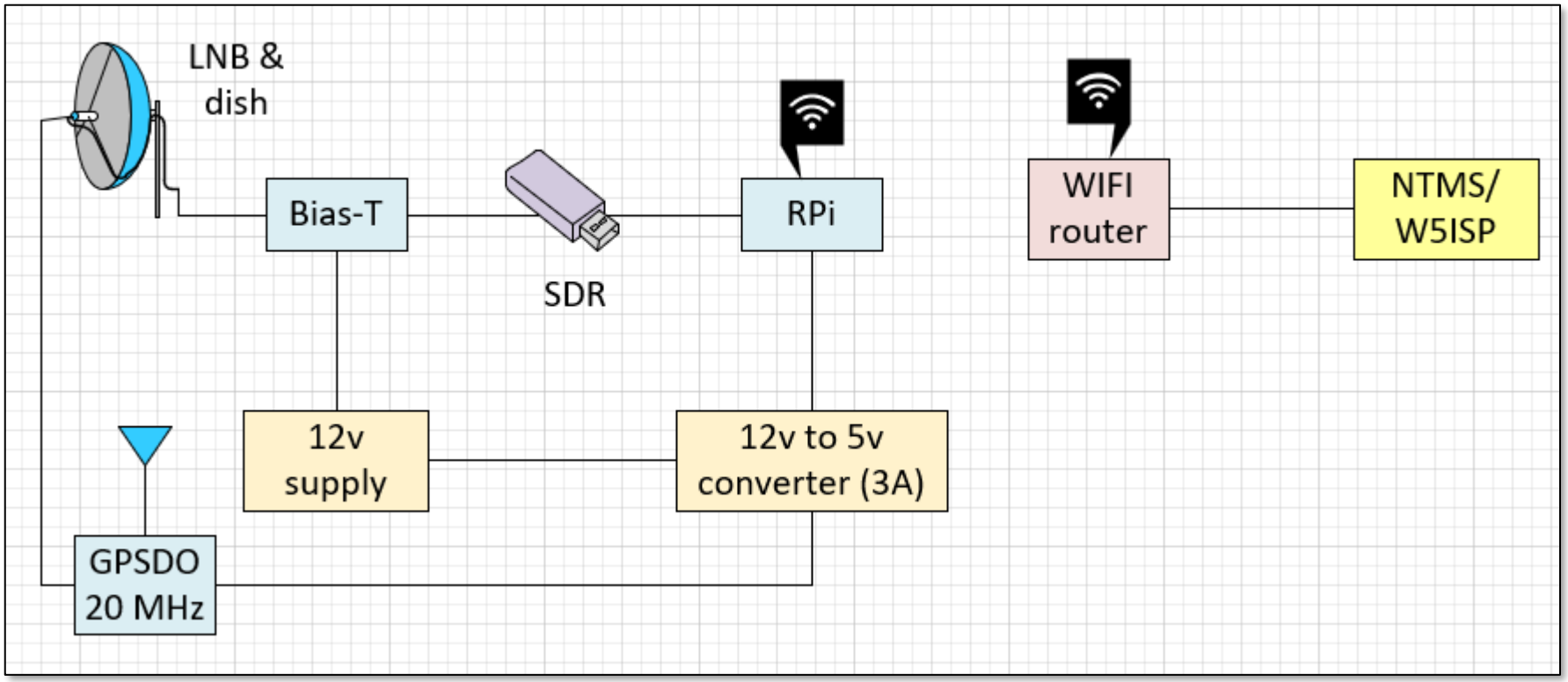
- Model #3, use existing equipment.



Monitor Designs

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- Model #4, highest stability 10 GHz design



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Model #4 Hi res system

- Bullseye modified to use external reference.
- Bodnar or other programmable GPSDO ref.
- Other components the same as Models 1 – 3.



4 Monitor Designs

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Model	Basic config	Function	Pro/Con
1	Indoor/Outdoor 10/24/47/? GHz	Microwave propagation	Low cost to high cost based on freq.
2	Indoor/Outdoor Less than 10 GHz	VHF/UHF propagation	Low cost to high cost based on freq.
3	Use existing (ops) equipment	Any frequency	Relatively low cost
4	Highest Stability	Very stable WSJT-X reporting	Higher cost

Software load and configuration

- For volunteer ops, NTMS can perform the configuration. We will use a short info form.
- For others:
  - Establish connection with Rpi.
  - Pull code from NTMS GitHub.
    - This will download the latest code.
  - Run calibration script[7].
  - Update monitor script to use gain/threshold values from calibration recommendation.
  - Start the monitor.
  - Validate the beacon is being received.

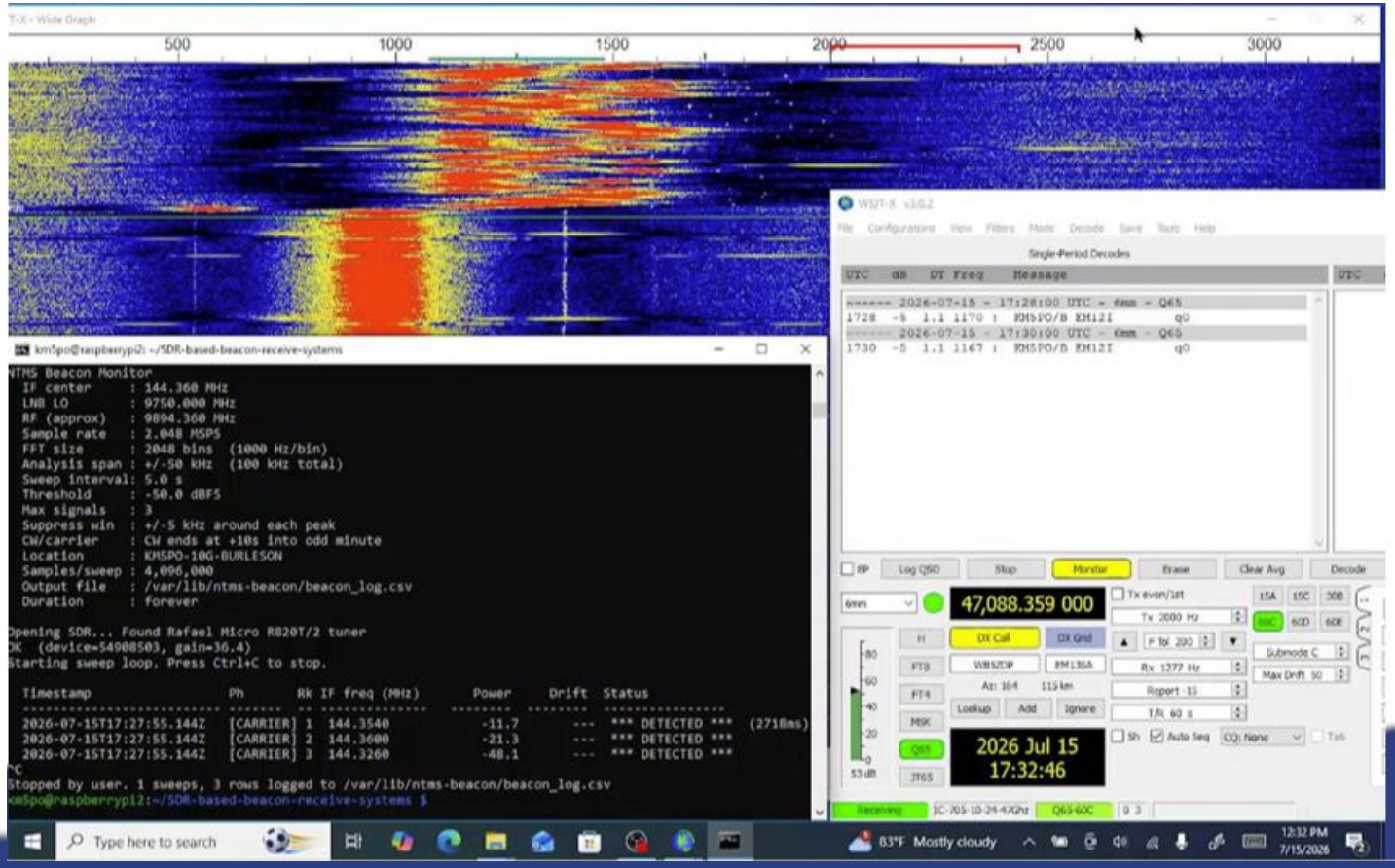
Install the monitor

- Choose a location.
  - Consider how the device will be powered.
  - Needs to be in-range of the WIFI connection or use an ethernet cable.
    - Indoor units in plastic case use WIFI antenna printed on Rpi PCB but can be fitted with external WIFI antenna.
    - Outdoor units in metal casing use external WIFI antenna.

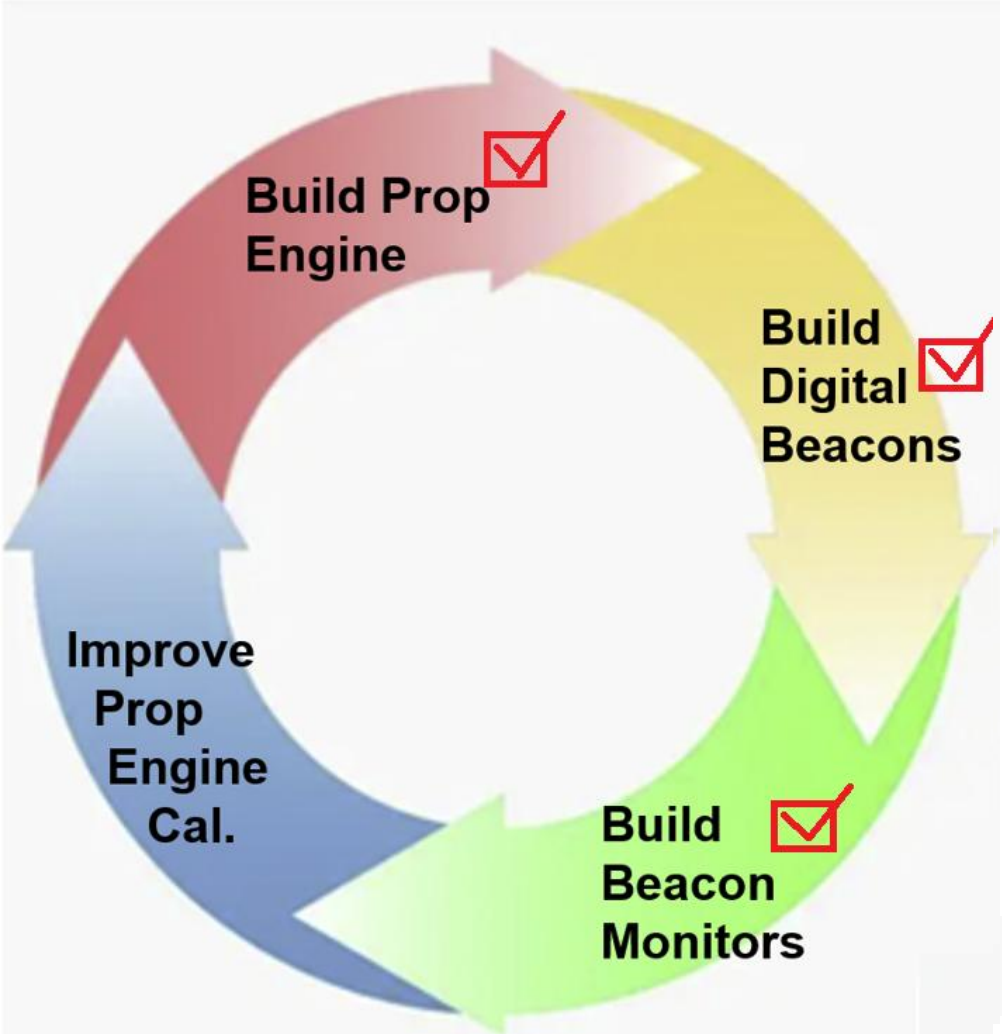
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Beacon monitor demo

[Demo: Receive two 47 GHz beacons through WSJT-X and NTMS beacon monitor.]



Accomplished so far



Improve Calibration

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- We need your help.
  - Adding more contacts and adding beacon reports, provides a larger base of scored events.
- ***Recalibration*** is a deliberate action.
  - This is performed when additional atmospherics or other physics data is obtained (last was 8/1/2026). Every contact is potentially rescored.
  - Go to this link to observe the considerations and the complexity of re-calibration: Full-corpus-per-band-recalibration

Improve Calibration

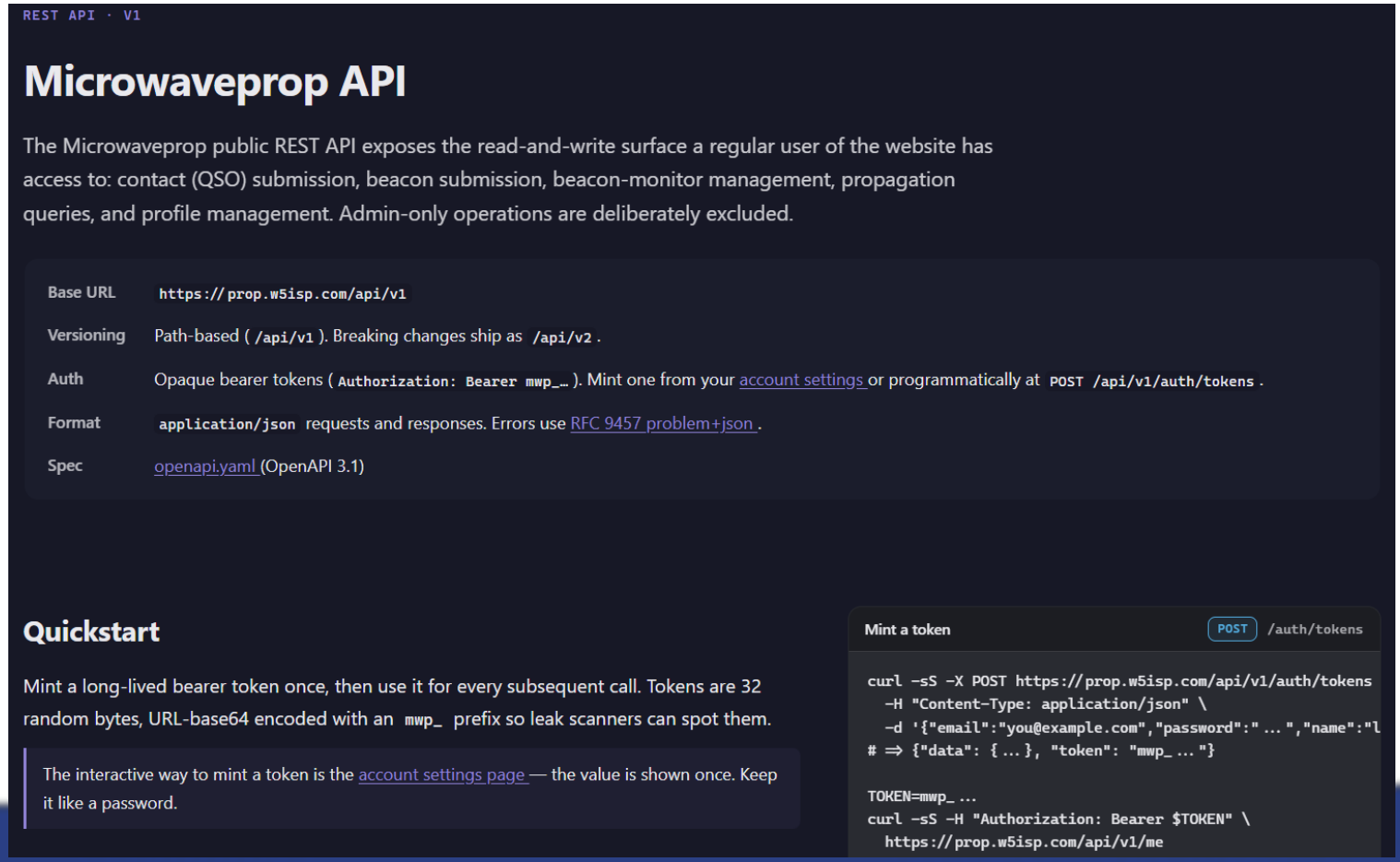
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- Please consider becoming part of the NTMS beacon monitoring network.
  - If you can host a beacon monitor, we can work with you to make it happen.
  - Publishing your local (and DX) beacon reports to the NTMS propagation engine serves your own area as well as the rest of us.
    - Single contacts one at a time.
    - ADIF or csv file imports.
  - Please let us know if some part of this project is of interest to you.

Interact with us

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Link to API documentation.



REST API · V1

Microwaveprop API

The Microwaveprop public REST API exposes the read-and-write surface a regular user of the website has access to: contact (QSO) submission, beacon submission, beacon-monitor management, propagation queries, and profile management. Admin-only operations are deliberately excluded.

Base URL	`https://prop.w5isp.com/api/v1`
Versioning	Path-based (`/api/v1`). Breaking changes ship as `/api/v2` .
Auth	Opaque bearer tokens (`Authorization: Bearer mwp_…`). Mint one from your account settings or programmatically at `POST /api/v1/auth/tokens` .
Format	`application/json` requests and responses. Errors use RFC 9457 problem+json .
Spec	openapi.yaml (OpenAPI 3.1)

Quickstart

Mint a long-lived bearer token once, then use it for every subsequent call. Tokens are 32 random bytes, URL-base64 encoded with an `mwp_` prefix so leak scanners can spot them.

> The interactive way to mint a token is the account settings page — the value is shown once. Keep it like a password.

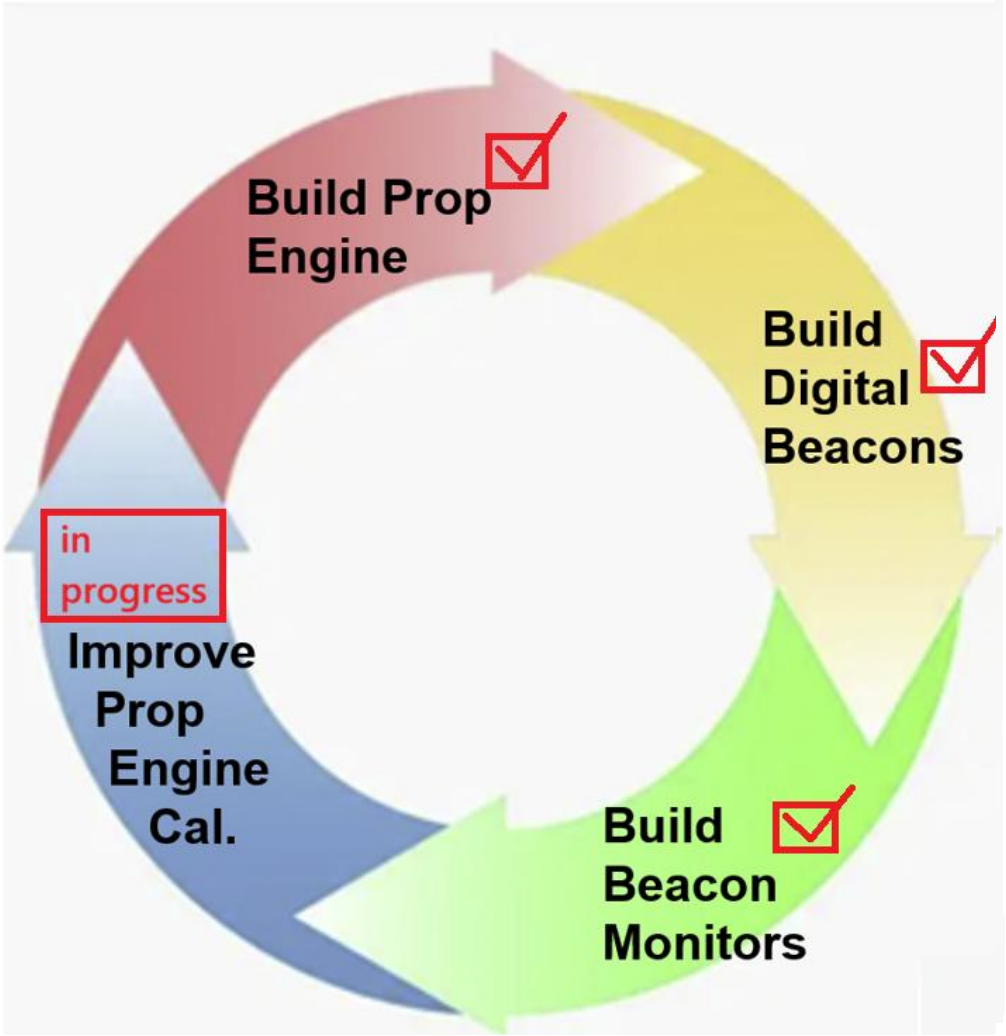
Mint a token — POST /auth/tokens

```
curl -sS -X POST https://prop.w5isp.com/api/v1/auth/tokens
  -H "Content-Type: application/json" \
  -d '{"email":"you@example.com","password":"…","name":"l
# ⇒ {"data": {…}, "token": "mwp_…"}

TOKEN=mwp_…
curl -sS -H "Authorization: Bearer $TOKEN" \
  https://prop.w5isp.com/api/v1/me
```

Accomplished

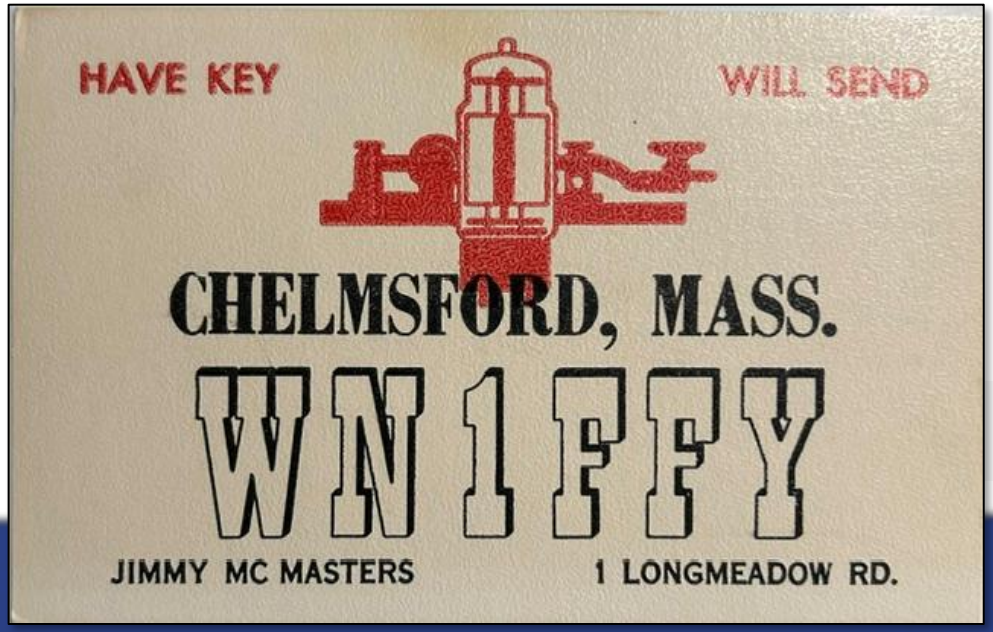
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Origins of a lifelong curiosity

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Using a crystal-controlled Heathkit “Twoer” – a 5-watt AM transceiver built around a regenerative receiver – feeding a dipole strapped to the chimney through 75 feet of RG-8 coax, I made a contact with a “W2” station on Long Island, New York, from Chelmsford, Massachusetts: a distance of roughly 200 miles.



Links and references

1. NTMS real-time propagation map, https://prop.w5isp.com/map
2. NTMS weather / atmospheric map, https://prop.w5isp.com/weather
3. NTMS Skew-T-Log-P, Skew-T · NTMS Microwave Propagation
4. NTMS beacons database, https://prop.w5isp.com/beacons
5. NTMS path calculator, https://prop.w5isp.com/path
6. Case Studies, Automated beacon receivers Part 2 and propagation studies
7. Calibration of beacon monitor pg 38-41, Calibrarion of Beacon Monitor pg. 38-41

Using the RFzero™ as a beacon driver for VHF, UHF, and beyond
Standalone 47 GHz beacon employing WSJT-X Q65D-60
Analysis and Forecasting mm-Wave Propagation – Part 1, https://ntms.org/files/Mar2026/Analysis%20and%20Forecasting%20mm-Wave%20propagatioin%20-%20Part%201.pdf
Analysis and Forecasting mm-Wave Propagation – Part 2, https://ntms.org/files/April2026/Analysis%20and%20Forecasting%20mm-Wave%20propagatioin%20-%20Part%202.pdf
NTMS propagation algorithm engine documentation, https://prop.w5isp.com/algo
NTMS contacts database, https://prop.w5isp.com/contacts
NTMS GitHub, North Texas Microwave Society · GitHub
Algorithm 1 NTMS original prop analyzer, mm-Wave Link Budget Analyzer
Algorithm 1 NTMS original mm-wave link budget analyzer, mm-Wave Link Budget Analyzer

Questions?

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