Amateur Satellite Communications

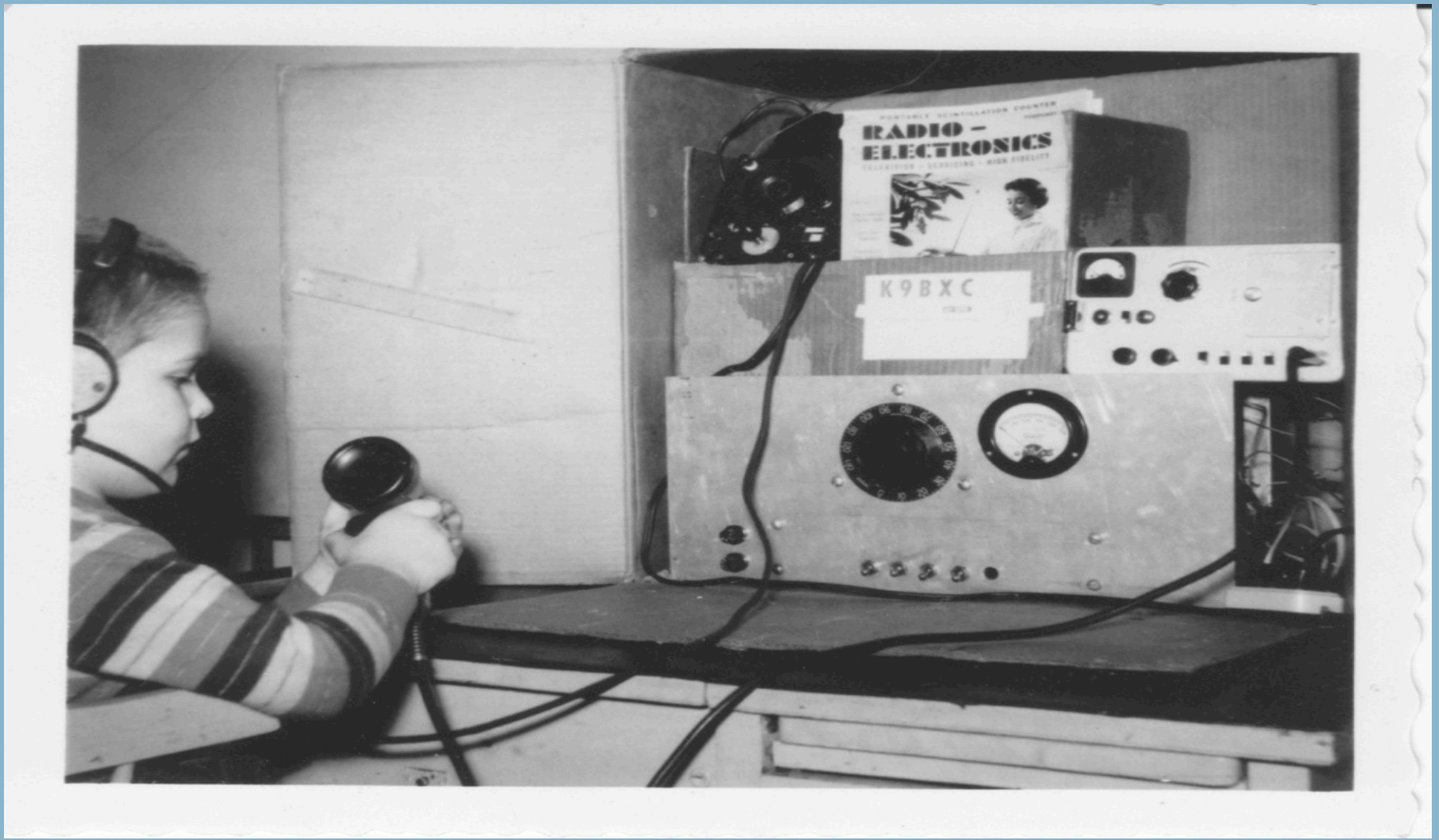
RMHAM University

2019

Intro

Doug, N6UA

Cheyenne, WY DN71qd



Young N6UA @ Dad's Station
1956

Licensed 1966 in Utah – WN7GFB

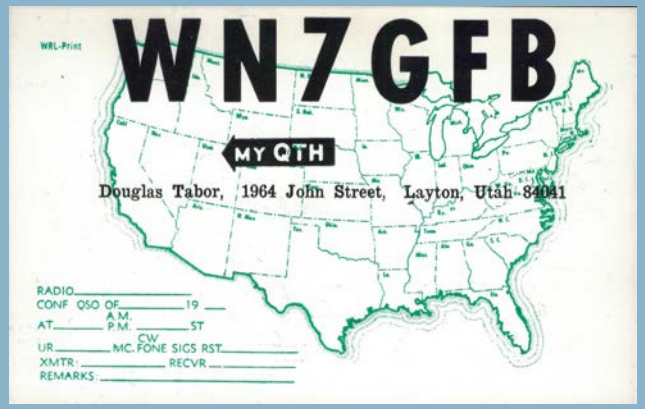
Sunspot Cycle - DX

Utah < 800 hams,

MARS, T-hunts,

2 meter AM & FM

Began operating Satellites Fall 2014



Pam K0ZXZ & I moved from
Estes Park to East Cheyenne, WY

Setting up Antennas,
DMR Radios, Workshop

Todays Agenda

- Satellites – Tech Stuff
- Best Practices
- Roving in 2018
- Show & Tell
- Q&A Welcome

Why?

Something new

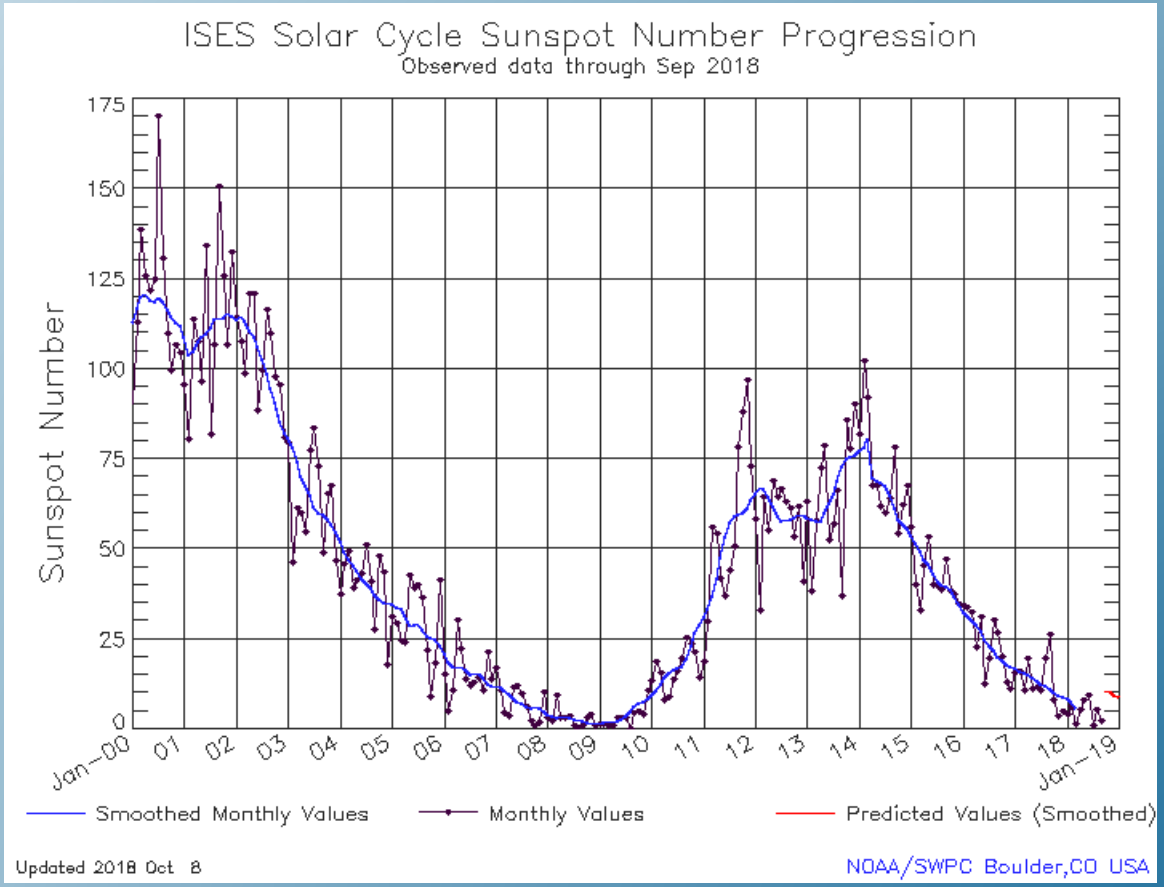
Tech License

Antenna restrictions

Expensive HF Equipment

Sun Spot cycle

Sun Spot Cycle Blues



Great time to experiment with satellites

Tech Stuff

Terms & Explanations

Equipment

Procedures

Satellite Types

- Transponder/Linear (CW/SS)
- FM repeater (voice, SSTV)

Orbits

Polar – Sun synchronous – 98°

Trans-equatorial – 43° inclination

Geostationary

Orbits

LEO – Low Earth Orbit

- 400 to 2,000 km
- 90 minute period
- In view ~1 to 15 minutes

Orbits

HEO – Highly Elliptical Orbit

- Up to 20,000 km
- 90+ minute period
- In view ~1 to 30 minutes

Orbits

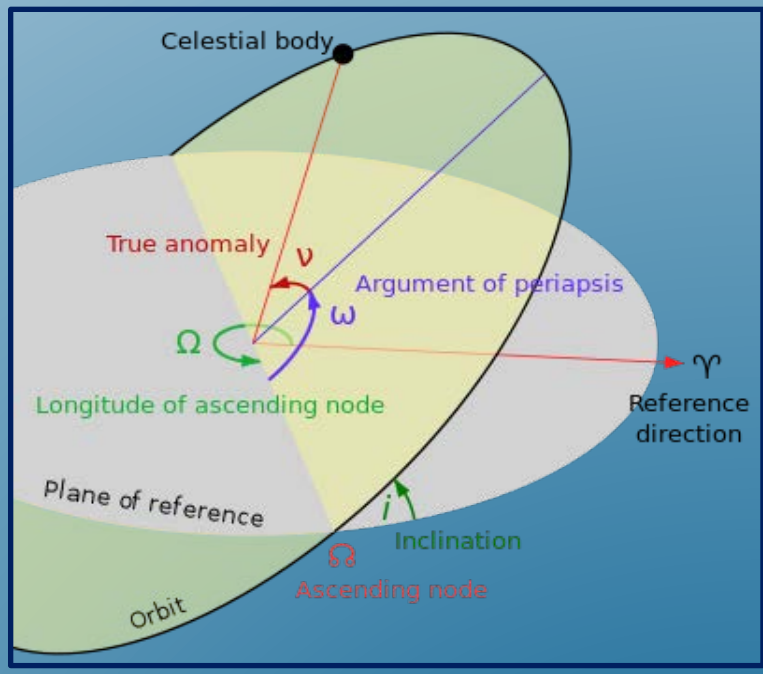
Geostationary

35,790 km above equator

Orbits

Keplerian Elements: "KEPS"

- Complete description of orbit
- Available on-line
- Software makes weekly update easy



Two-Line-Element (TLE)

- NASA Format

```
NOAA 14
1 23455U 94089A   97320.90946019  .00000140  00000-0  10191-3 0  2621
2 23455  99.0090 272.6745 0008546 223.1686 136.8816 14.11711747148495
```

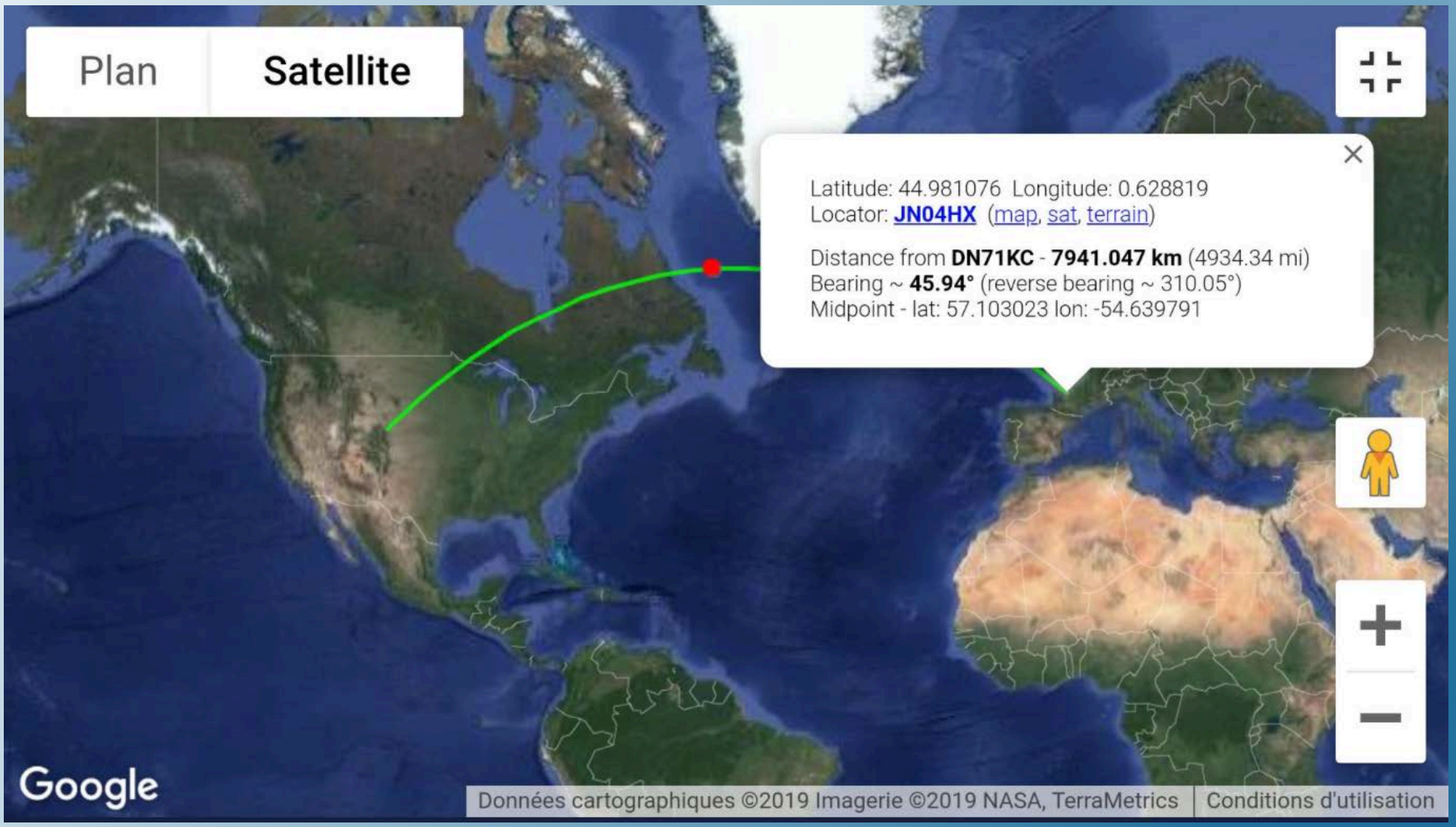
Footprint

What is seen on Earth

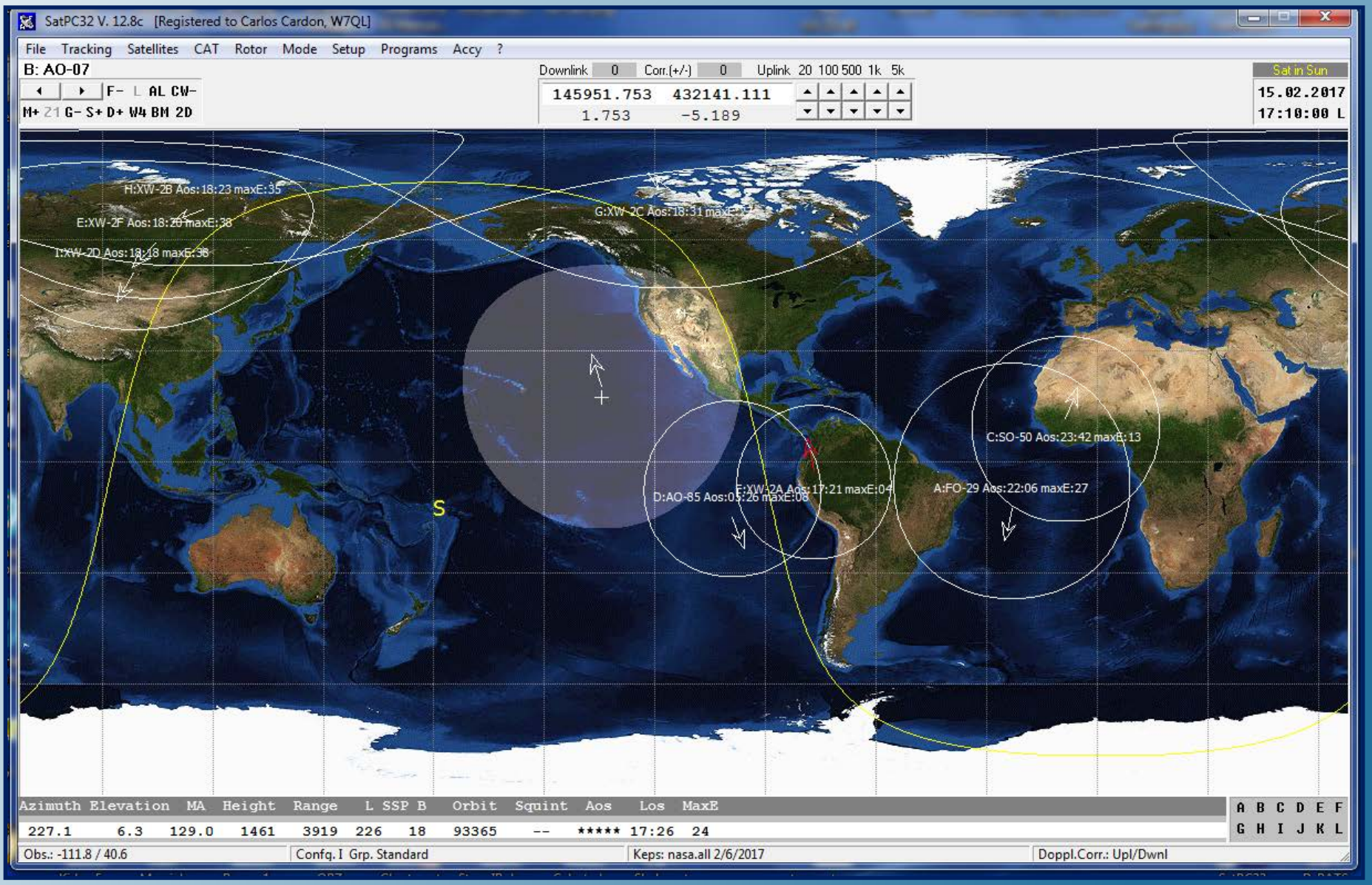
AO-40 Record 18,730 km

AO-7(B) 8,060 km from Colorado to SW France

Footprint


Plan
Satellite
Latitude: 44.981076 Longitude: 0.628819
Locator: JN04HX (map, sat, terrain)
Distance from DN71KC - 7941.047 km (4934.34 mi)
Bearing ~ 45.94° (reverse bearing ~ 310.05°)
Midpoint - lat: 57.103023 lon: -54.639791
Google
Données cartographiques ©2019 Imagerie ©2019 NASA, TerraMetrics
Conditions d'utilisation

Footprint


SatPC32 V. 12.8c [Registered to Carlos Cardon, W7QL]
File Tracking Satellites CAT Rotor Mode Setup Programs Accy ?
B: AO-07
Downlink 0 Corr.(+/-) 0 Uplink 20 100 500 1k 5k
145951.753 432141.111
1.753 -5.189
Sat in Sun
15.02.2017
17:10:00 L
H:XW-2B Aos:18:23 maxE:35
E:XW-2F Aos:18:20 maxE:38
I:XW-2D Aos:18:18 maxE:38
G:XW-2C Aos:18:31 maxE:
C:SO-50 Aos:23:42 maxE:13
D:AO-85 Aos:05:26 maxE:08
E:XW-2A Aos:17:21 maxE:04
A:FO-29 Aos:22:06 maxE:27
S
Azimuth Elevation MA Height Range L SSP B Orbit Squint Aos Los MaxE
227.1 6.3 129.0 1461 3919 226 18 93365 -- ***** 17:26 24
Obs.: -111.8 / 40.6
Confq. I Grp. Standard
Keps: nasa.all 2/6/2017
Doppl.Corr.: Upl/Dwnl

AOS/LOS/TCA

Acquisition Of Signal

Loss Of Signal

TCA – Time Closest Approach

Uplink/Downlink

FM Cross-band repeater

Transponder (passband)

Modes - nomenclature

Modes

Upper Case/lower case

(UPLINK/downlink)

E.g. SO-50/FO-29 are V/u,

Most are U/v

Modes

Mode (old)	Mode (new)	Uplink	Downlink
K		21 MHz	29 MHz
T		21 MHz	145 MHz
A		145 MHz	29 MHz
J	V/u	145 MHz	435 MHz
B	U/v	435 MHz	145 MHz
S	U/s	435 MHz	2400 MHz
L	L/u	1268 MHz	435 MHz
	L/s	1268 MHz	2400 MHz
	L/x	1268 MHZ	10450 MHz
	L/v	1268 MHZ	145 MHz

Doppler Shift

More on higher frequencies or on shorter wavelengths

Doppler Shift by band

Distance	145.9 MHz	435.0 MHz	1280 MHz	2401 MHz
800 KM	+/- 3.0	+/- 9.0	+/- 26.2	+/- 49.6
1500 KM	+/- 2.9	+/- 8.6	+/- 25.0	+/- 47.3
8000 KM	+/- 2.1	+/- 6.4	+/- 18.5	+/- 35.0

Shift in KHz

Inverting vs Non-Inverting

Uplink UHF LSB, Downlink VHF USB (XW-2C)

Listening 145.800 - 5 Khz from bottom

Transmitting 435.165 - 5 Khz from top

Passbands – Are from 20 KHz to 100 KHz wide
Adjust for Doppler

Non-linear vs Linear Transponders

FM

SSB, CW

Operational Amateur Satellites

Linear Transponders

FO-29 (Offline)

AO-7

CAS-4A/B

XW-2A/F (-C/E/D)

AO-73 (FUNcube-1)

EO-88 (when eclipse)

JO-97 (Commissioning)

FO-99 (Commissioning)

QO-100 (13cm/3cm)

FM Repeaters

SO-50

AO-91/92/95 (Failed?)

AO-85 (Degraded)

PO-101

LilacSat-2

Others (digital)

NO-84 (PSAT)

AiSat1

ISS Packet

IO-86

FalconSAT-3

Digital Operation

Most Satellites have telemetry data

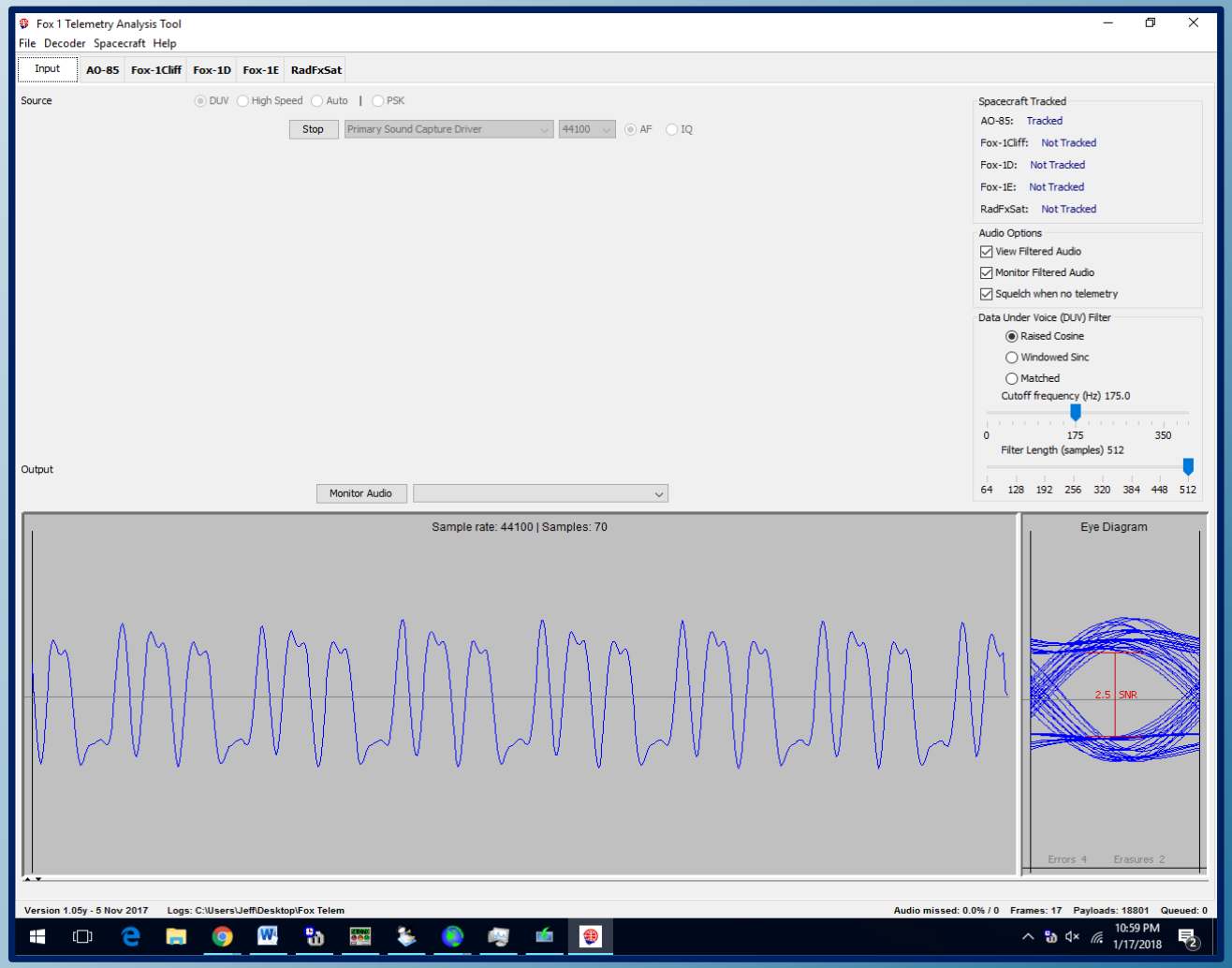
- AO-85/91/92, AO-73, EO-88, JO-97, CO-57, NO-84 and others telemetry-only
- XW-series FSK
- NO-84 BPSK

Science Missions primary for many/most

ISS

- Packet digipeater 145.825 MHz

AMSAT Fox Series Telemetry



Data-Under-Voice (DUV)

AMSAT

Radio Amateur Satellite Corporation

Formed in 1969, successor to Project OSCAR

- "Orbiting Satellite Carrying Amateur Radio"

Promotes Amateur Radio in space

- Produced over 60 amateur satellites
- Currently Operate AO-7, AO-85, AO-91, AO-92

FM Cross-Band Repeaters

SO-50, AO-85
AO-91, AO-92
PO-101

SO-50

Launch: December 2002

Mode/Uplink: V/u FM 145.850 MHz

Mode/Downlink: V/u FM 436.795 MHz

Orbit: Polar LEO 596 x 713 kM

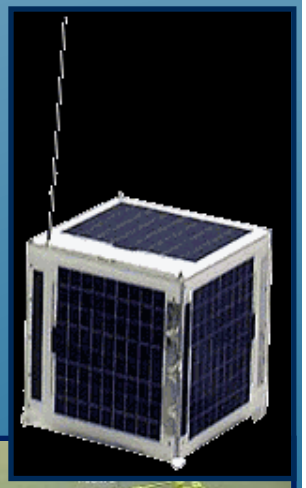
Power: 250 mW

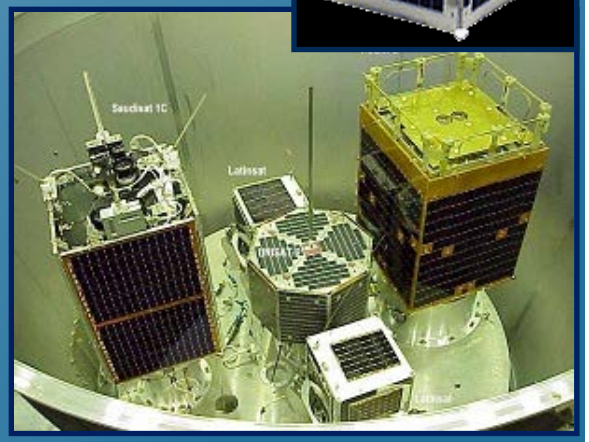
Notes:

Satellite PL Tone 67.0 Hz

Startup PL tone 74.4 Hz (10 min timer)

Polarization fades





Fox Series: AO-85/91/92/95

Launches: AO-85 Oct 2015, AO-91 Nov2017,
AO-92 Jan 2018

Mode/Downlink: U/v FM Transponder 145 MHz band

Orbit: LEO 520 x 810 kM

Power: 400 – 800 mW

Notes:

- Popular FM satellites
- Good signals from AO-91/92
- AO-85 Battery issues
- AO-95 not operational
- AO-92 changed to L/v by ground command

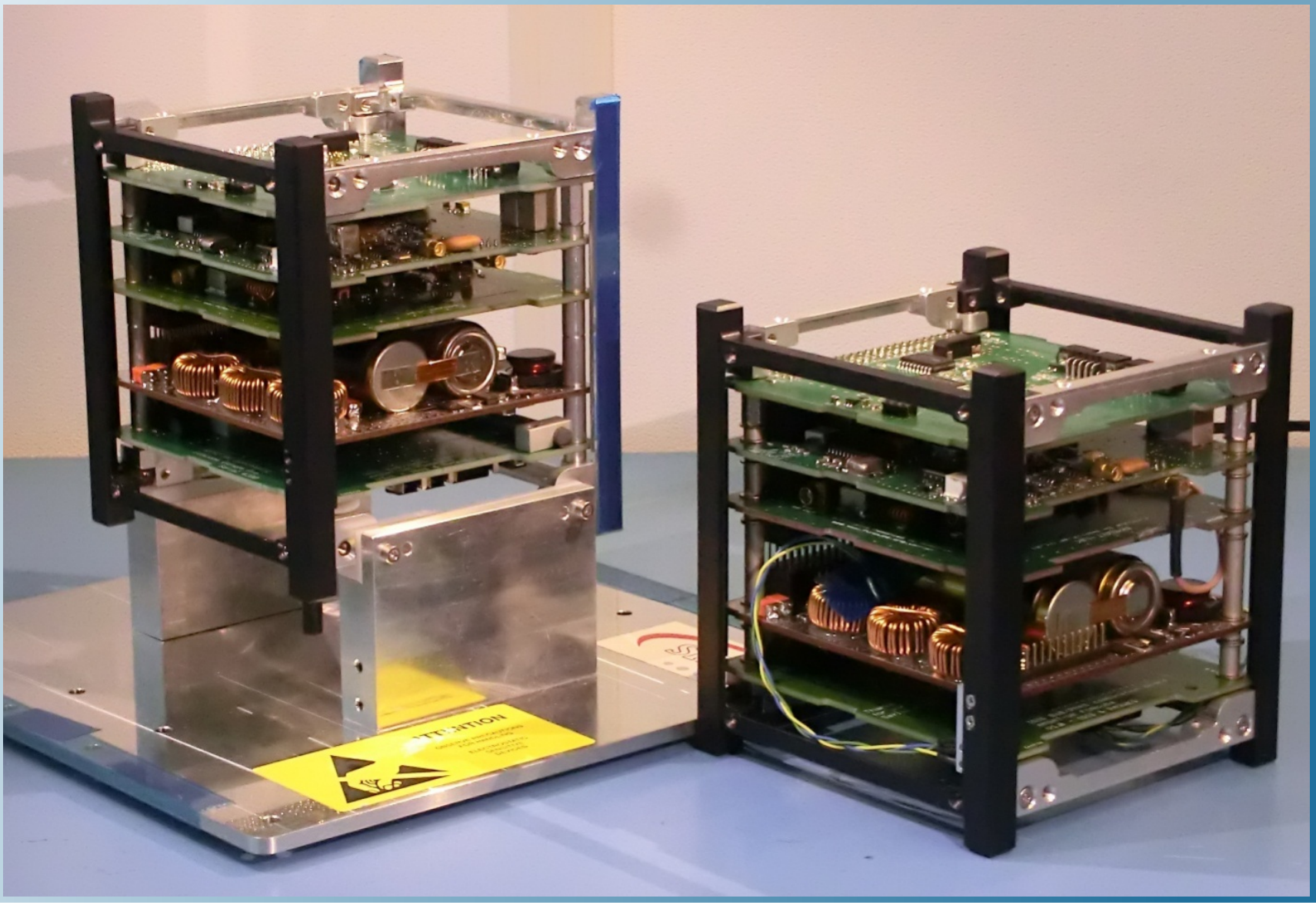
CURRENT “CubeSats”

U-Class Payload

10cm cube (4” x 4” x 4”)

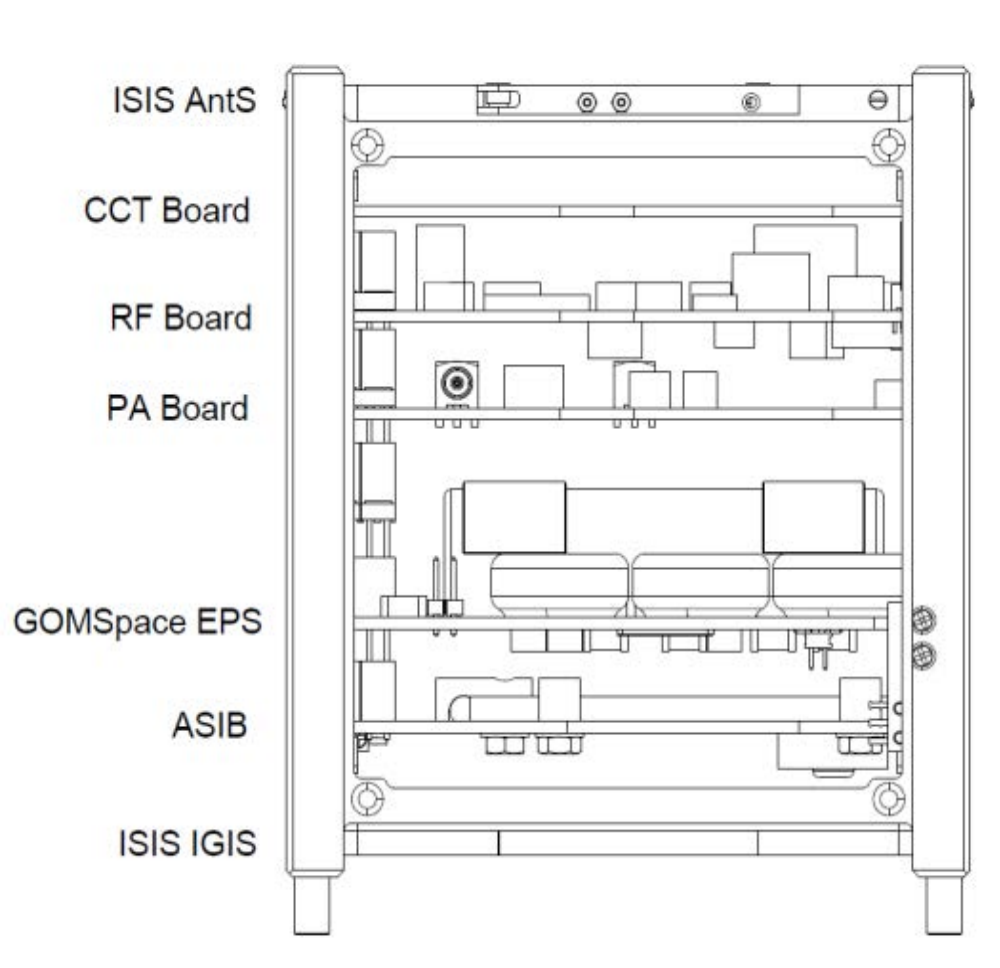
Less than 1.33 Kg (3 pounds)

CURRENT “CubeSats”



CURRENT “CubeSat”

What’s inside?



PO-101

Launch: October 29, 2018

Mode/Uplink: U/v FM 145.900 MHz

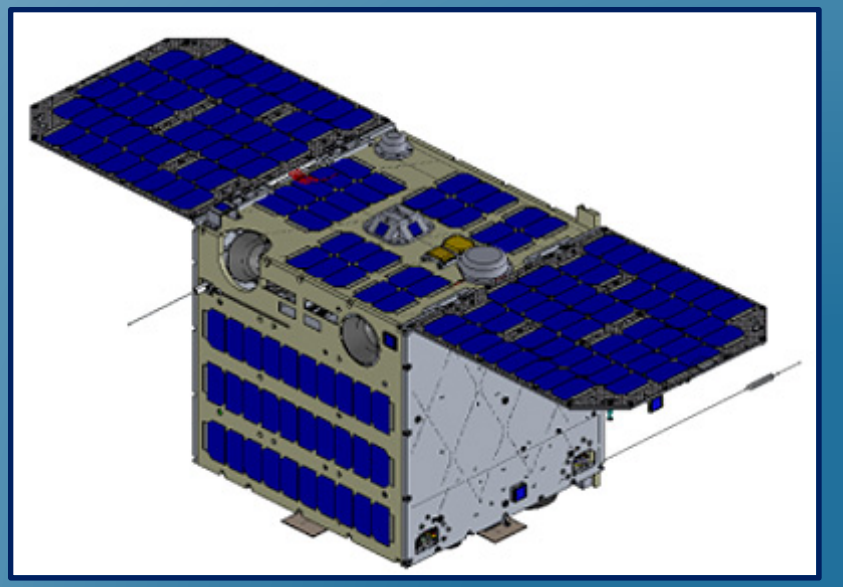
Mode/Downlink: U/v FM 437.700 MHz

Orbit: Polar LEO 595 x 616 kM

Power: 300 mW

Notes:

Built by Philippine students w/ Japanese mentors and launch

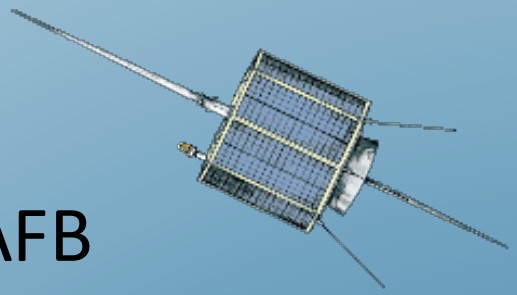


Linear Transponders

AO-7, AO-73, EO-88, FO-29

JO-97*, XW-2s, CAS-4A-B

AO-7



Launch: November 1974 Vandenburg AFB

Mode/Downlink: V/a, U/v 145.925 – 145.975 MHz

Orbit: Polar LEO, 1400 x 1459 kM

Power: 8 W

Notes:

- Oldest operational satellite
- Stopped 1981, came back June 2002 (batteries open)
- Operates only in sun
- High orbit, good footprint, DX likely
- Downlink distortion when transponder saturated
- Power surges (saturation) cause mode reset (flipping)

Chinese CAS-4A/B

Launch: June 2017, Jiuquan Launch Center

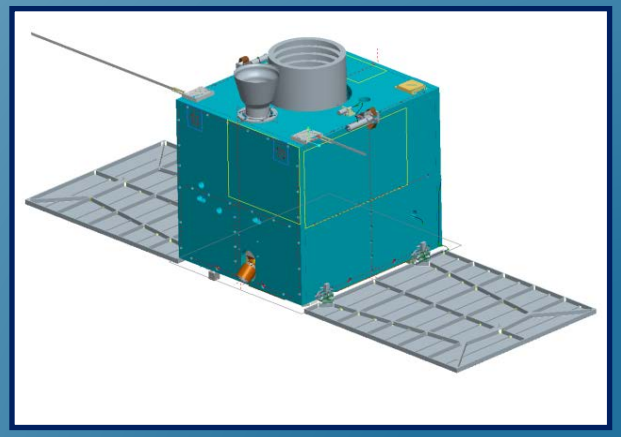
Mode/Downlink: U/v Linear Inverting Transponders

Orbit: ~42 Trans-equatorial, 524 kM apogee

Power: 100 mW

Notes:

- Good signal strength
- Good footprint in Mountain States
- Not used extensively



Chinese XW-2 A-F (CAS-3)

Launch: Sept 2015, Taiyuan Launch Center

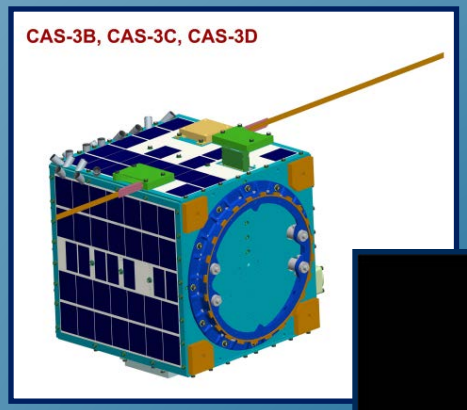
Mode/Downlink: U/v Linear Inverting Transponders

Orbit: Polar SSO, 528 x 551 kM

Power: 100 mW

Notes:

- Four active satellites 2A, 2B, 2C, 2F
- Excellent signal strength/stable
- Sequential Orbital Passes



International Space Station

ARISS

"**A**mateur **R**adio (on) **I**nternational **S**pace **S**tation"

Astronauts

Infrequent opportunities for QSO

Scheduled contacts with schools

1200 Baud Packet/APRS

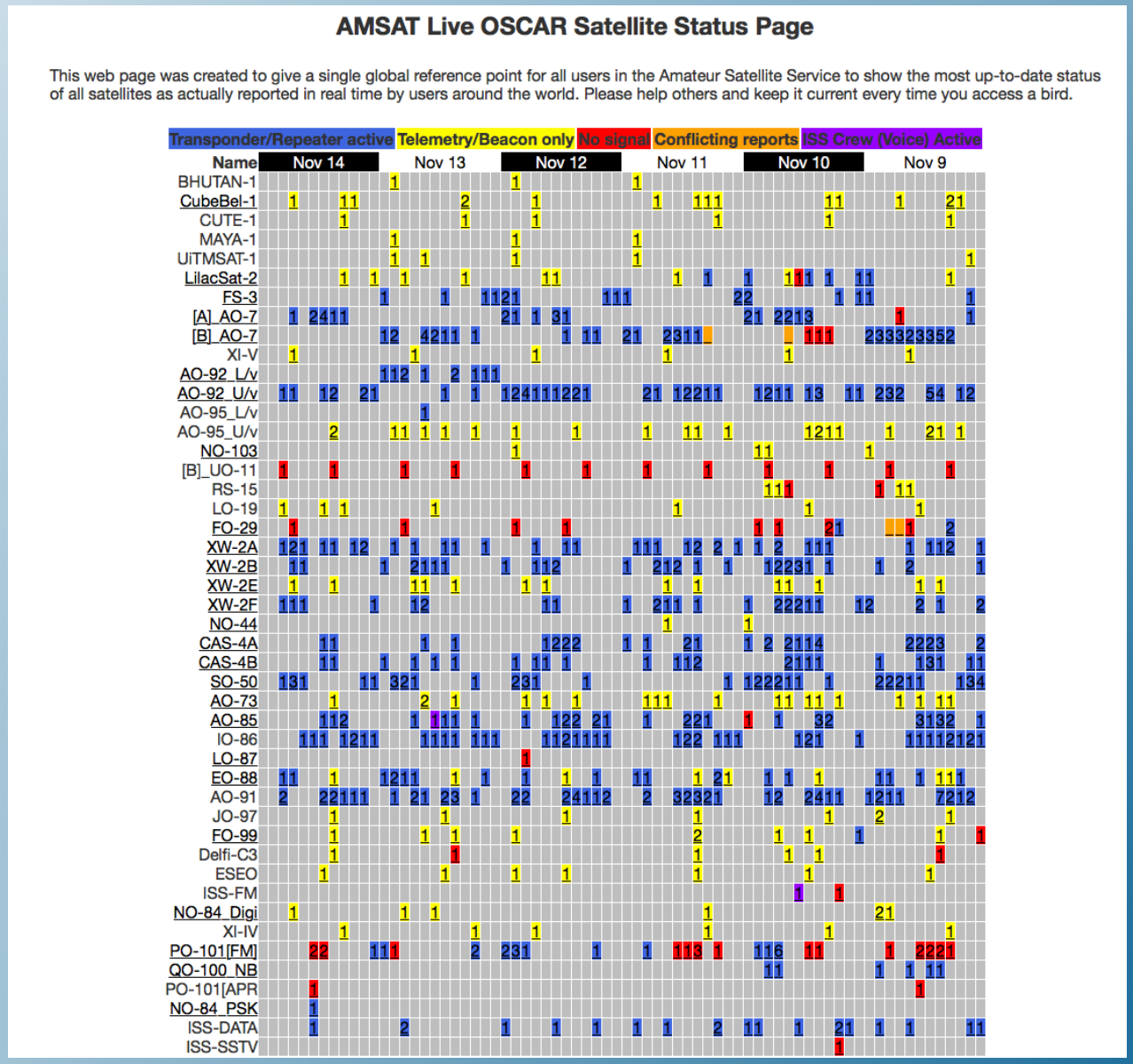
145.825 MHz

Resources

http://www.issfanclub.com/

http://www.ariss.org/

AMSAT Satellite Status



AMSAT Pass Prediction

AMSAT™

AMSAT Online Satellite Pass Predictions

10605 Concord St, #304
Kensington, MD 20895
1-888-322-6728

AMSAT Online Satellite Pass Predictions - AO-91

View the current location of AO-91

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
14 Nov 19	19:40:34	00:08:36	214	10	258	322	19:49:10
15 Nov 19	05:52:05	00:10:33	41	9	84	141	06:02:38
15 Nov 19	07:27:16	00:13:51	10	79	299	197	07:41:07
15 Nov 19	09:05:04	00:09:20	342	8	299	254	09:14:24
15 Nov 19	16:51:30	00:04:58	87	3	59	31	16:56:28
15 Nov 19	18:24:13	00:10:51	161	67	52	351	18:35:04
15 Nov 19	20:03:18	00:06:28	234	4	262	310	20:09:46
16 Nov 19	06:12:50	00:12:14	32	17	94	155	06:25:04
16 Nov 19	07:48:43	00:13:43	5	46	271	208	08:02:26
16 Nov 19	09:27:22	00:06:48	332	3	305	271	09:34:10

Your results are shown above

Use the form below to request more pass predictions

Show Predictions for: AO-91 **for Next** 10 **Passes**

Calculate Latitude and Longitude from Gridsquare: DM79 Calculate Position

Or

Enter Decimal Latitude:* 39.5 North

Enter Decimal Longitude:* 105 West

Elevation in meters AMSL: 1500

Predict

☐ **Save my location for later use**

For the best in full featured tracking software visit The AMSAT Store

Based on the Predict engine, courtesy of John Magliacane, KD2BD
2019 Nov 14 19:00:29 UTC

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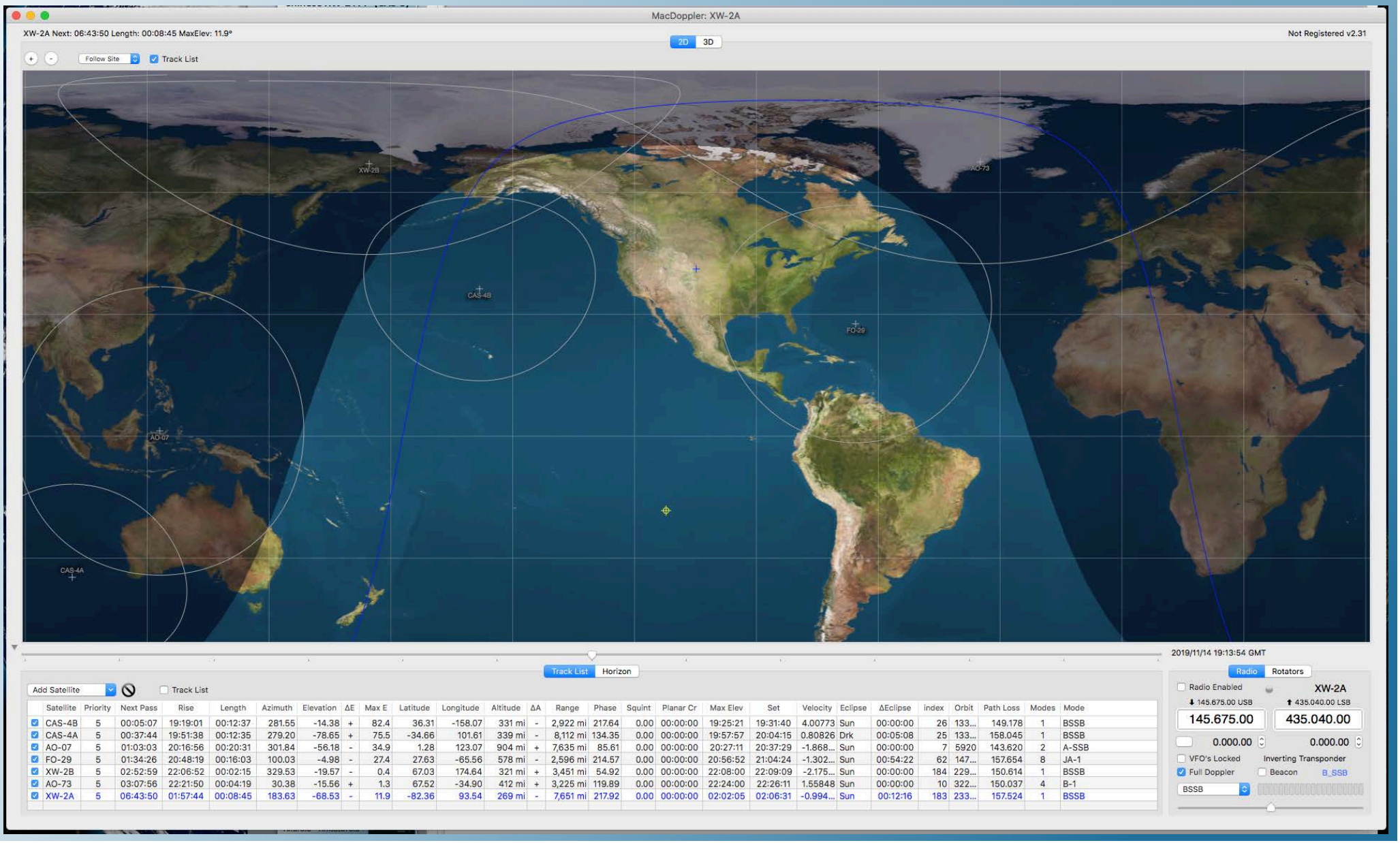
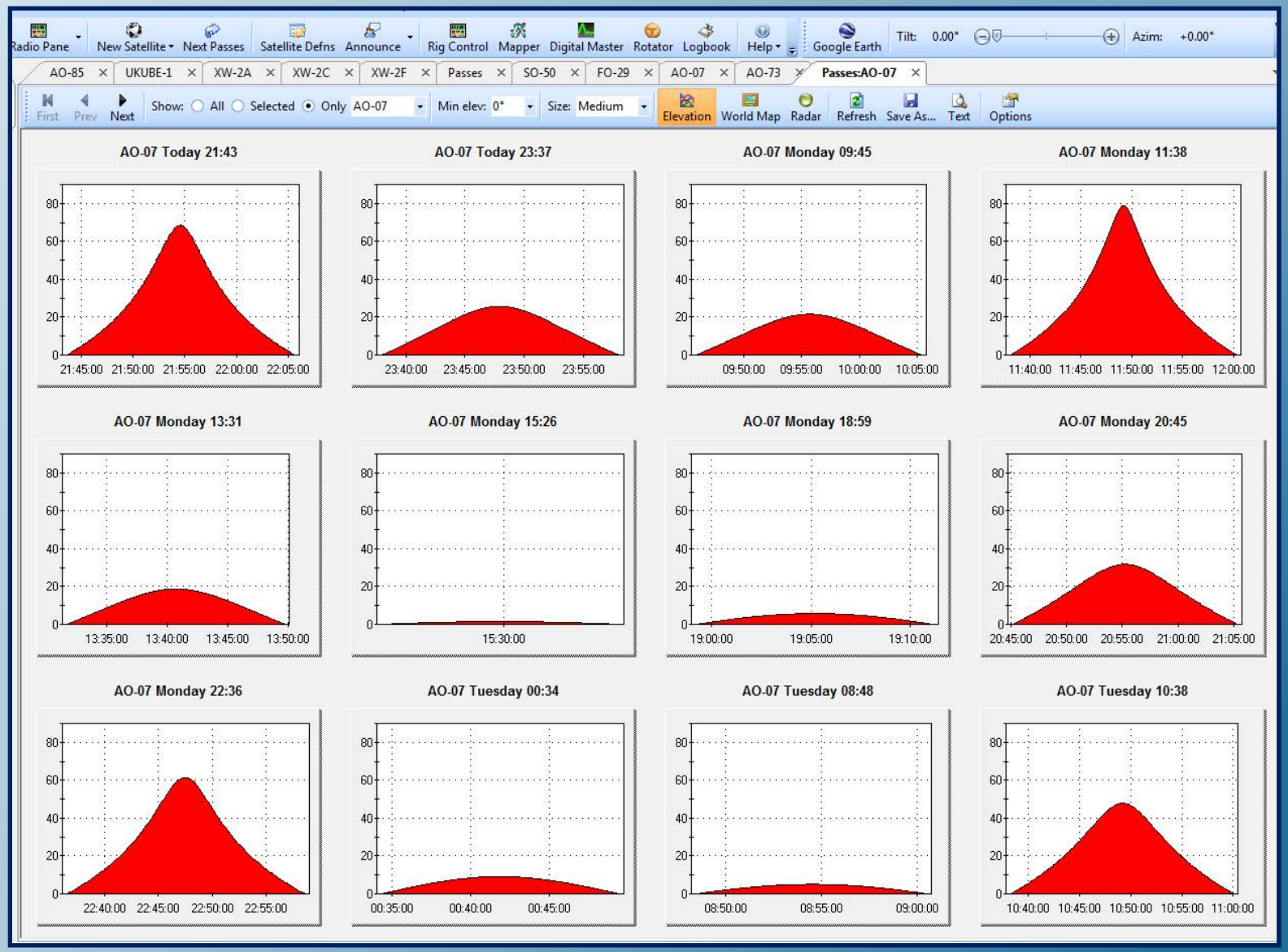
Report a bug on this page

MacDoppler Pass Prediction



	Satellite	Priority	Next Pass	Rise	Length	Azimuth	Elevation	ΔE	Max E	Latitude	Longitude	Altitude	ΔA	Range	Phase	Squint	Planar Cr	Max Elev	Set	Velocity	Eclipse	ΔEclipse	index	Orbit	Path Loss	Modes	Mode
☑	CAS-4B	5	00:05:07	19:19:01	00:12:37	281.55	-14.38	+	82.4	36.31	-158.07	331 mi	-	2,922 mi	217.64	0.00	00:00:00	19:25:21	19:31:40	4.00773	Sun	00:00:00	26	133...	149.178	1	BSSB
☑	CAS-4A	5	00:37:44	19:51:38	00:12:35	279.20	-78.65	+	75.5	-34.66	101.61	339 mi	-	8,112 mi	134.35	0.00	00:00:00	19:57:57	20:04:15	0.80826	Drk	00:05:08	25	133...	158.045	1	BSSB
☑	AO-07	5	01:03:03	20:16:56	00:20:31	301.84	-56.18	-	34.9	1.28	123.07	904 mi	+	7,635 mi	85.61	0.00	00:00:00	20:27:11	20:37:29	-1.868...	Sun	00:00:00	7	5920	143.620	2	A-SSB
☑	FO-29	5	01:34:26	20:48:19	00:16:03	100.03	-4.98	-	27.4	27.63	-65.56	578 mi	-	2,596 mi	214.57	0.00	00:00:00	20:56:52	21:04:24	-1.302...	Sun	00:54:22	62	147...	157.654	8	JA-1
☑	XW-2B	5	02:52:59	22:06:52	00:02:15	329.53	-19.57	-	0.4	67.03	174.64	321 mi	+	3,451 mi	54.92	0.00	00:00:00	22:08:00	22:09:09	-2.175...	Sun	00:00:00	184	229...	150.614	1	BSSB
☑	AO-73	5	03:07:56	22:21:50	00:04:19	30.38	-15.56	+	1.3	67.52	-34.90	412 mi	+	3,225 mi	119.89	0.00	00:00:00	22:24:00	22:26:11	1.55848	Sun	00:00:00	10	322...	150.037	4	B-1
☑	XW-2A	5	06:43:50	01:57:44	00:08:45	183.63	-68.53	-	11.9	-82.36	93.54	269 mi	-	7,651 mi	217.92	0.00	00:00:00	02:02:05	02:06:31	-0.994...	Sun	00:12:16	183	233...	157.524	1	BSSB

HRD Pass Prediction

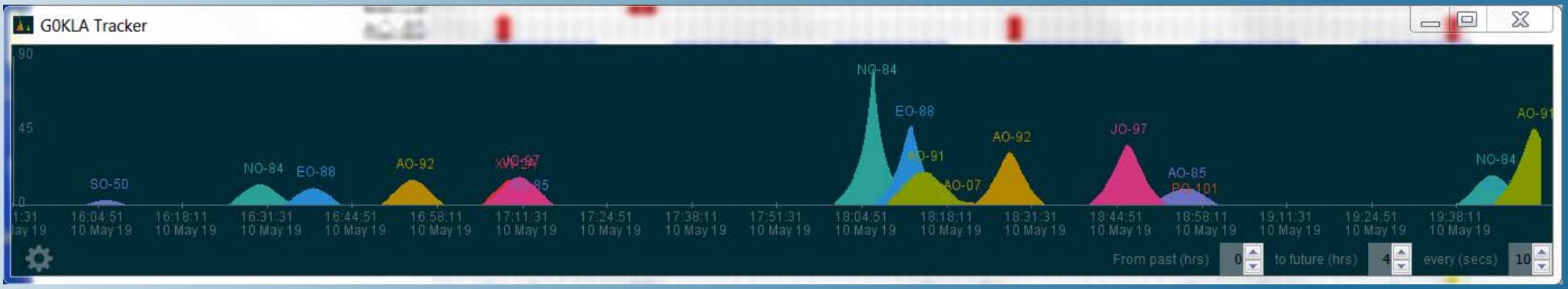


G0KLA Pass Tracker

Handy planning tool – JAVA based

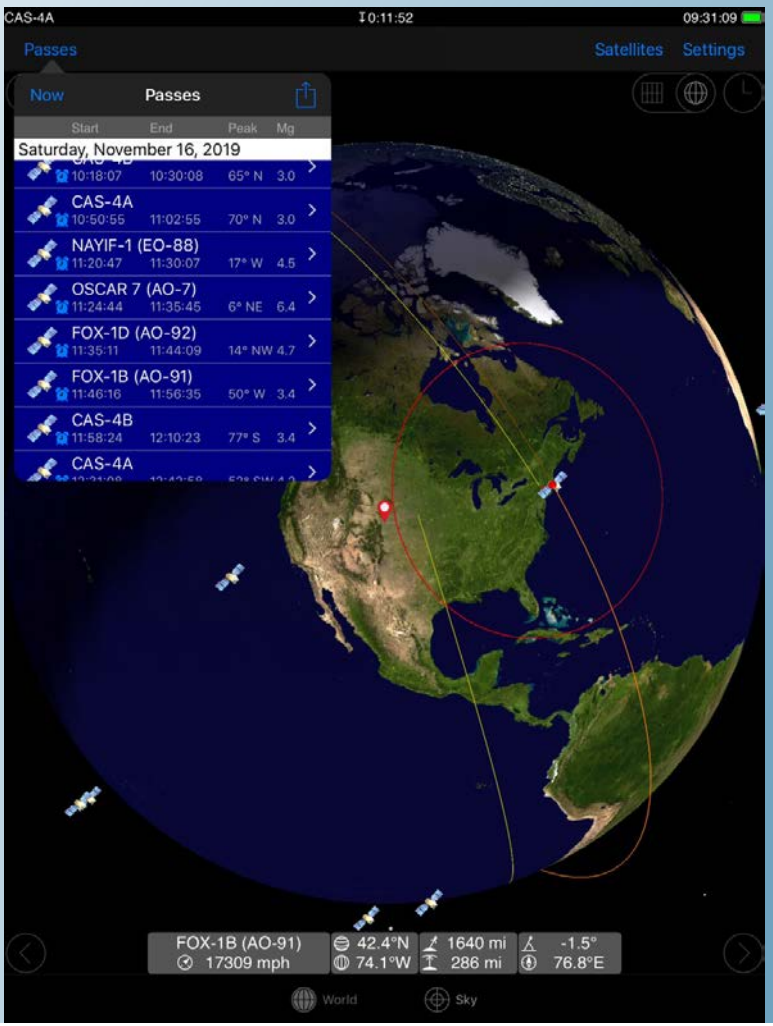
Configurable

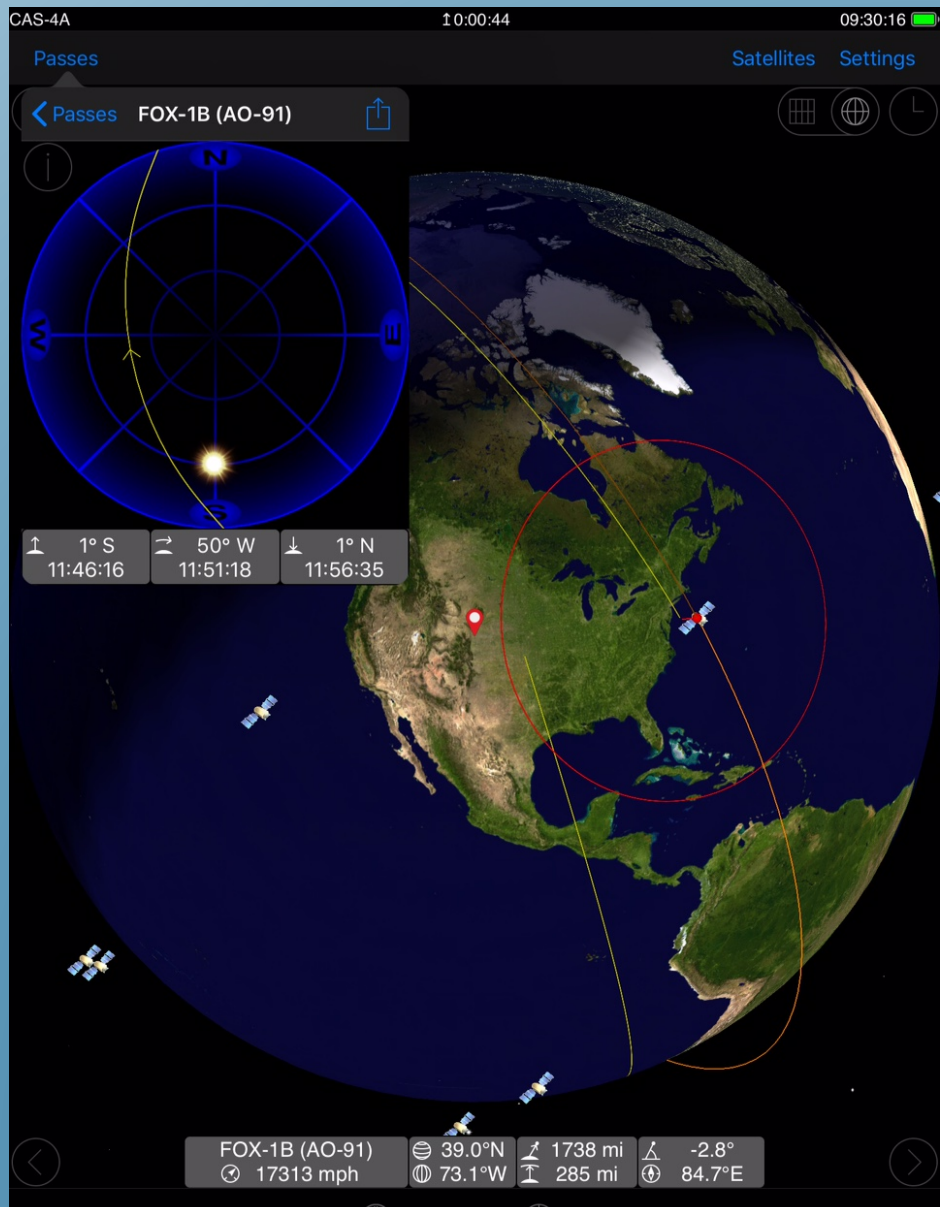
Runs on bottom of screen



iOS – Android Apps

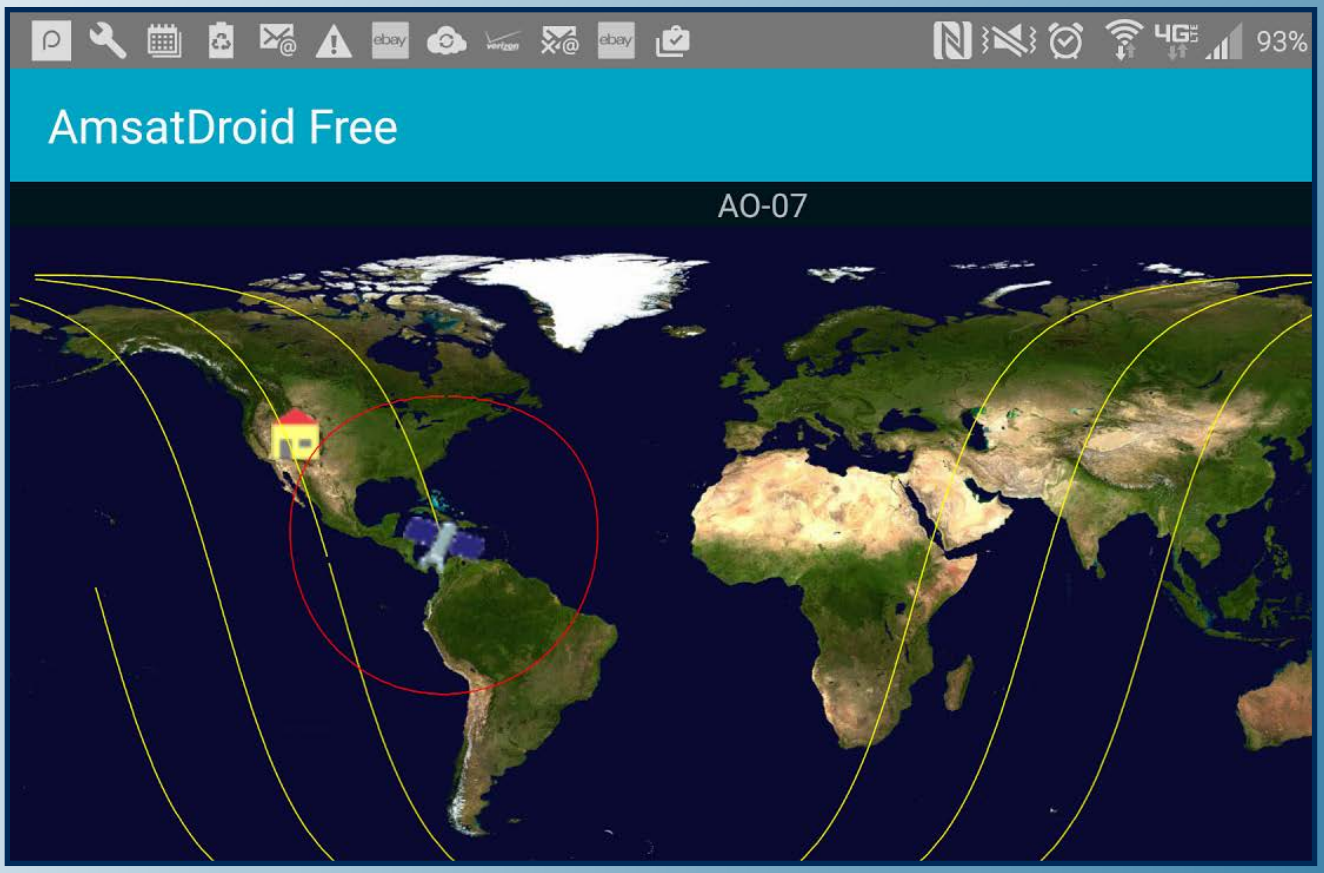
iOS - GoSatWatch

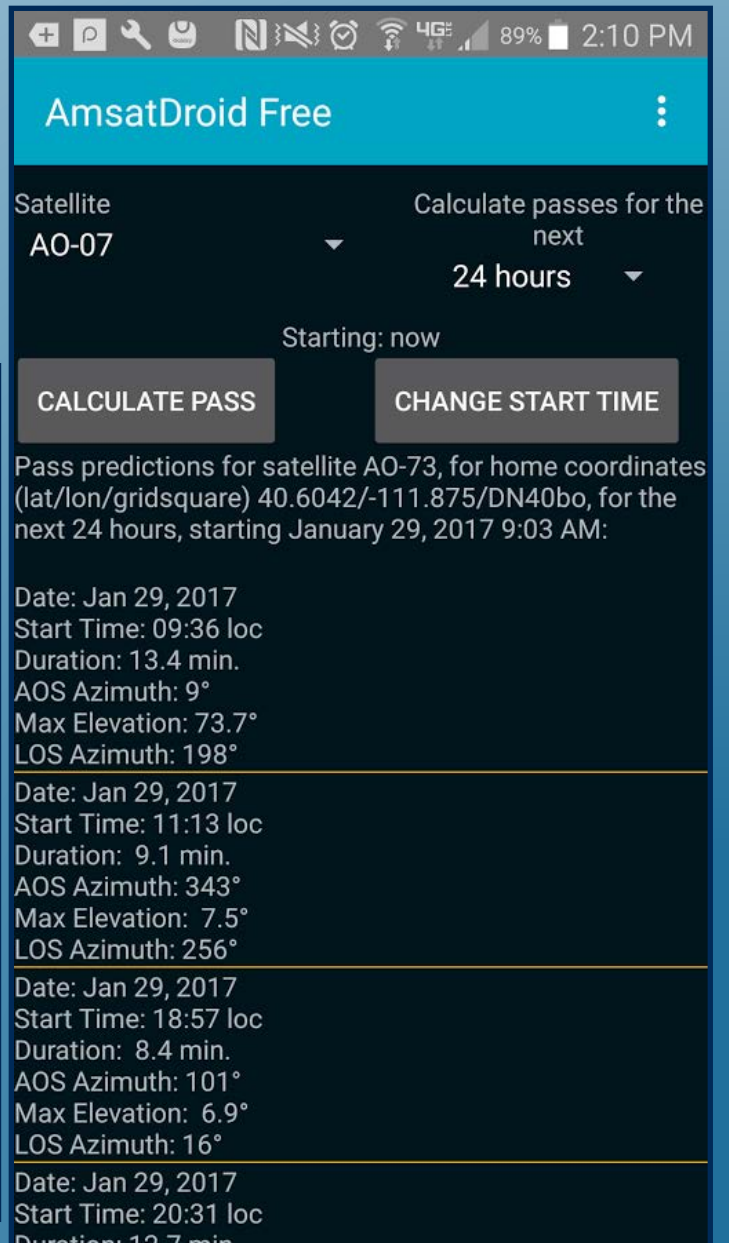




iOS – Android Apps

Android – AmsatDroid



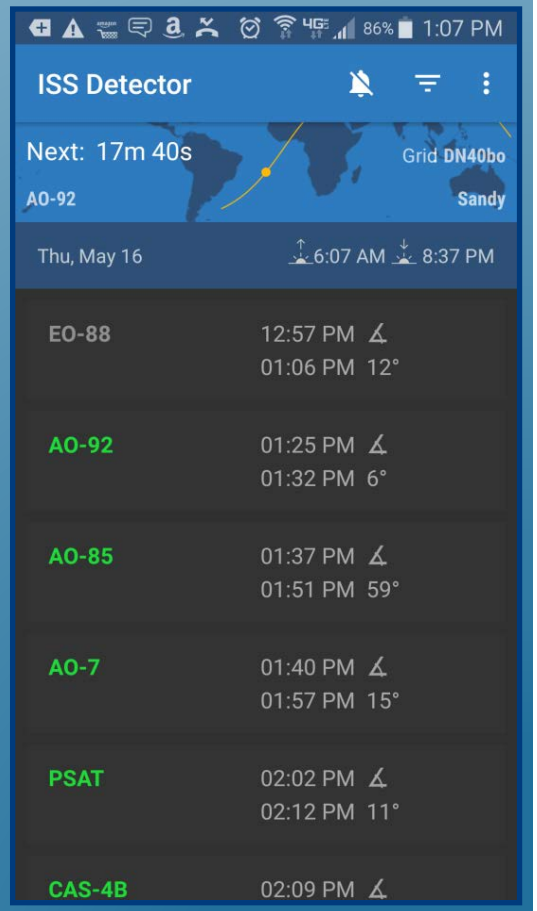


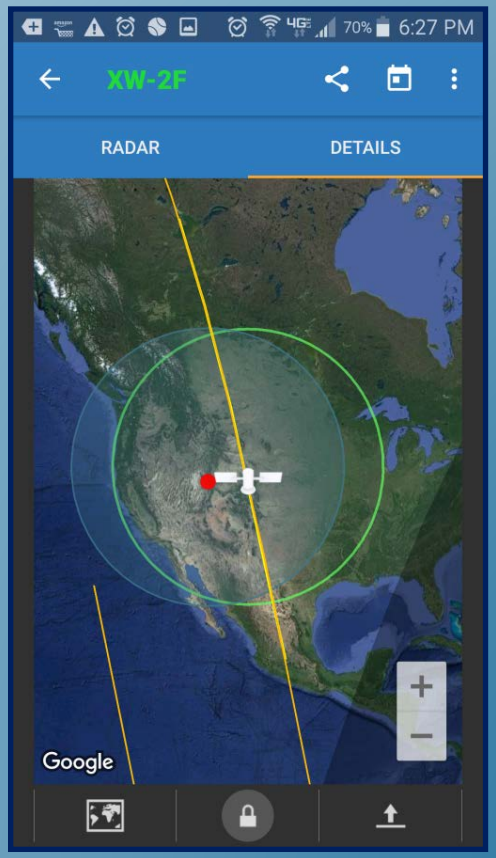
ISS Detector Pro

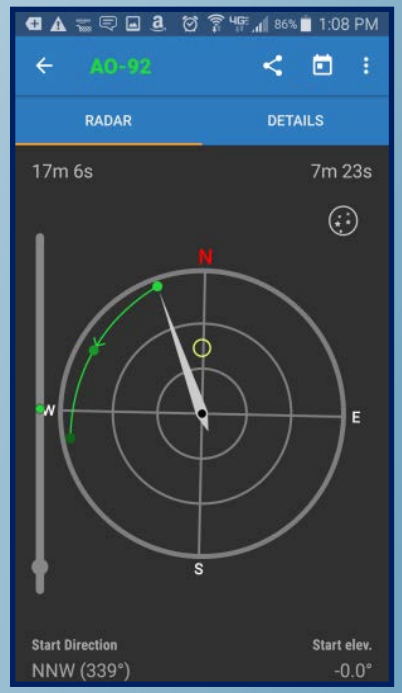
Selectable Sats

Great Maps

Android







SatPC32 Control Software

Sold by AMSAT

Erich Eichmann DK1TB

Tracks + Maps Satellites

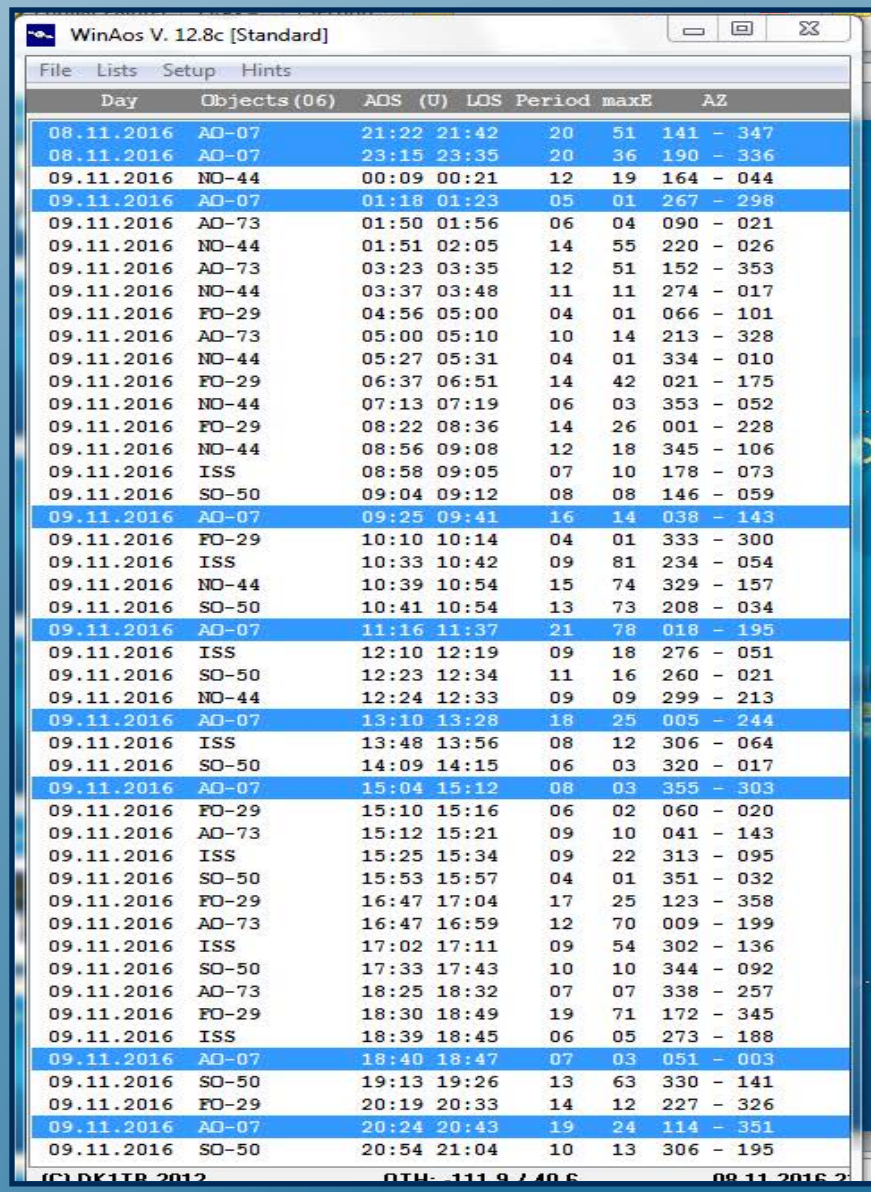
Controls rig(s) for Doppler

Drives Az-El rotator

Predicts Satellite passes

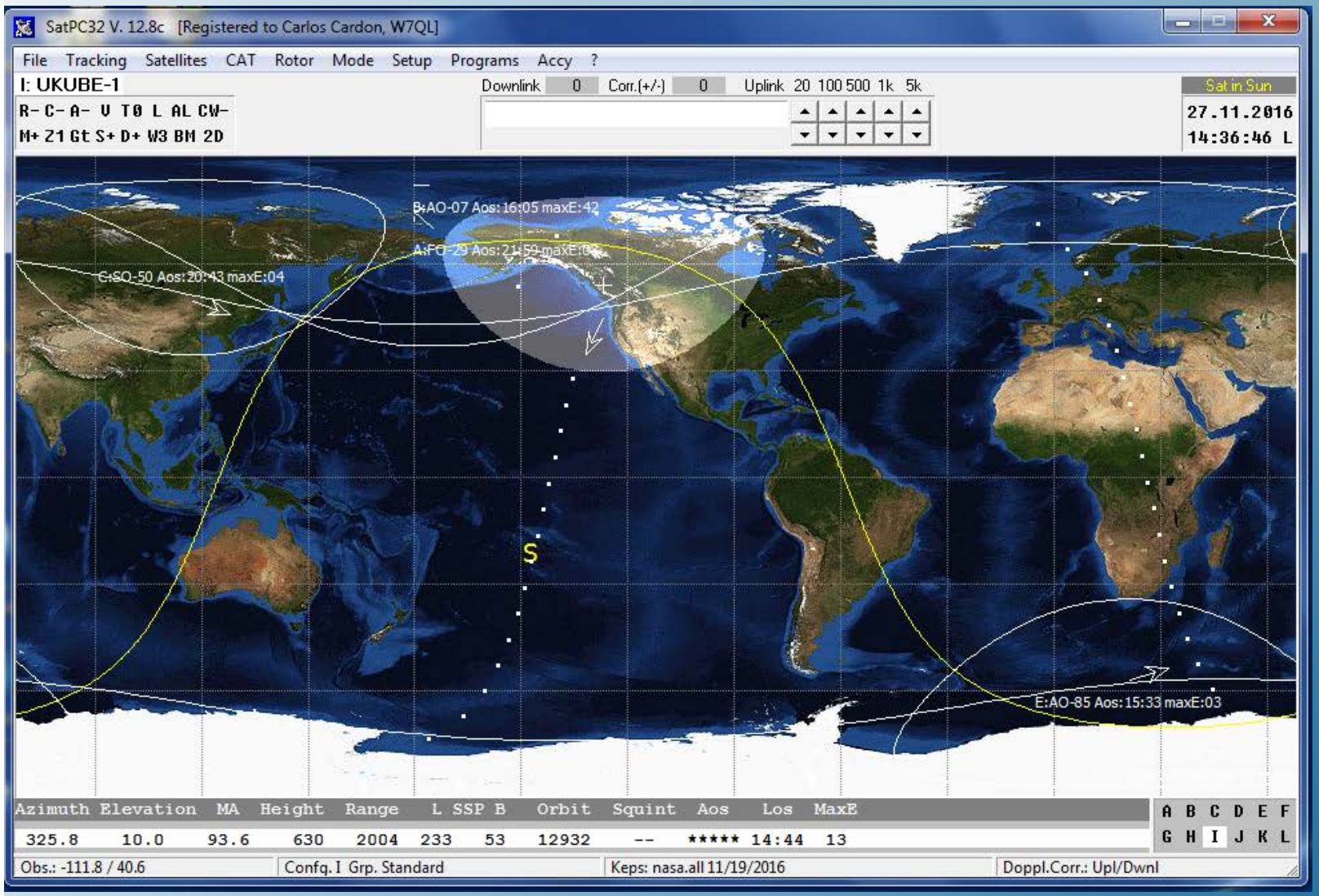
Sets frequencies + modes

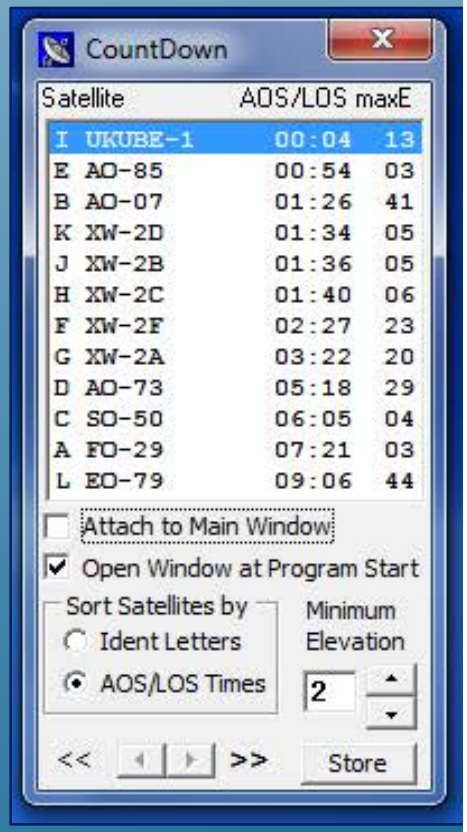
Satellite visibility between any two locations



Day	Objects(06)	AOS	(U)	LOS	Period	maxE	AZ
08.11.2016	AO-07	21:22	21:42	20	51	141	- 347
08.11.2016	AO-07	23:15	23:35	20	36	190	- 336
09.11.2016	NO-44	00:09	00:21	12	19	164	- 044
09.11.2016	AO-07	01:18	01:23	05	01	267	- 298
09.11.2016	AO-73	01:50	01:56	06	04	090	- 021
09.11.2016	NO-44	01:51	02:05	14	55	220	- 026
09.11.2016	AO-73	03:23	03:35	12	51	152	- 353
09.11.2016	NO-44	03:37	03:48	11	11	274	- 017
09.11.2016	FO-29	04:56	05:00	04	01	066	- 101
09.11.2016	AO-73	05:00	05:10	10	14	213	- 328
09.11.2016	NO-44	05:27	05:31	04	01	334	- 010
09.11.2016	FO-29	06:37	06:51	14	42	021	- 175
09.11.2016	NO-44	07:13	07:19	06	03	353	- 052
09.11.2016	FO-29	08:22	08:36	14	26	001	- 228
09.11.2016	NO-44	08:56	09:08	12	18	345	- 106
09.11.2016	ISS	08:58	09:05	07	10	178	- 073
09.11.2016	SO-50	09:04	09:12	08	08	146	- 059
09.11.2016	AO-07	09:25	09:41	16	14	038	- 143
09.11.2016	FO-29	10:10	10:14	04	01	333	- 300
09.11.2016	ISS	10:33	10:42	09	81	234	- 054
09.11.2016	NO-44	10:39	10:54	15	74	329	- 157
09.11.2016	SO-50	10:41	10:54	13	73	208	- 034
09.11.2016	AO-07	11:16	11:37	21	78	018	- 195
09.11.2016	ISS	12:10	12:19	09	18	276	- 051
09.11.2016	SO-50	12:23	12:34	11	16	260	- 021
09.11.2016	NO-44	12:24	12:33	09	09	299	- 213
09.11.2016	AO-07	13:10	13:28	18	25	005	- 244
09.11.2016	ISS	13:48	13:56	08	12	306	- 064
09.11.2016	SO-50	14:09	14:15	06	03	320	- 017
09.11.2016	AO-07	15:04	15:12	08	03	355	- 303
09.11.2016	FO-29	15:10	15:16	06	02	060	- 020
09.11.2016	AO-73	15:12	15:21	09	10	041	- 143
09.11.2016	ISS	15:25	15:34	09	22	313	- 095
09.11.2016	SO-50	15:53	15:57	04	01	351	- 032
09.11.2016	FO-29	16:47	17:04	17	25	123	- 358
09.11.2016	AO-73	16:47	16:59	12	70	009	- 199
09.11.2016	ISS	17:02	17:11	09	54	302	- 136
09.11.2016	SO-50	17:33	17:43	10	10	344	- 092
09.11.2016	AO-73	18:25	18:32	07	07	338	- 257
09.11.2016	FO-29	18:30	18:49	19	71	172	- 345
09.11.2016	ISS	18:39	18:45	06	05	273	- 188
09.11.2016	AO-07	18:40	18:47	07	03	051	- 003
09.11.2016	SO-50	19:13	19:26	13	63	330	- 141
09.11.2016	FO-29	20:19	20:33	14	12	227	- 326
09.11.2016	AO-07	20:24	20:43	19	24	114	- 351
09.11.2016	SO-50	20:54	21:04	10	13	306	- 195

SatPC32 Main Screen





EQUIPMENT

Expen$ive

On a budget ¢

EQUIPMENT

Full vs Half Duplex

Why?

EQUIPMENT

Transceivers

Yaesu: FT-847, **FT-818**, **FT-857D**, FT-736R, **FT-991A** Icom: IC-910H, IC-9100, **IC-9700**, IC-706MKIIG

Kenwood TS-2000, TS-790A

More EQUIPMENT

Yagi or Circular-Polarized Antennas

Tower

Low Noise Amplifier (LNA)

- SSB SP-70
- ARR (Advanced Receiver Research)
- Down-East Microwave

EQUIPMENT

Dual-axis Rotator

- Yaesu G-5500
- Alfa-SPID
- M2

Hardline – LMR-600UF

Lots of compute

Satellite Antennas

Gain Antenna

- Rubber-duck not sufficient for transmission
- Full-duplex operation: diplexer or dual antennas

Rotator

- Antenna max lobe in direction of satellite
- Can set EL for 20-35 degrees and use Az only

Radio Horizon

- Mountains and obstructions

Polarization

- Circular generally best
- Fades with satellite geometry
- Polarization switching helps

EQUIPMENT - Cheap

2 Cheapo HTs (V & U) FM

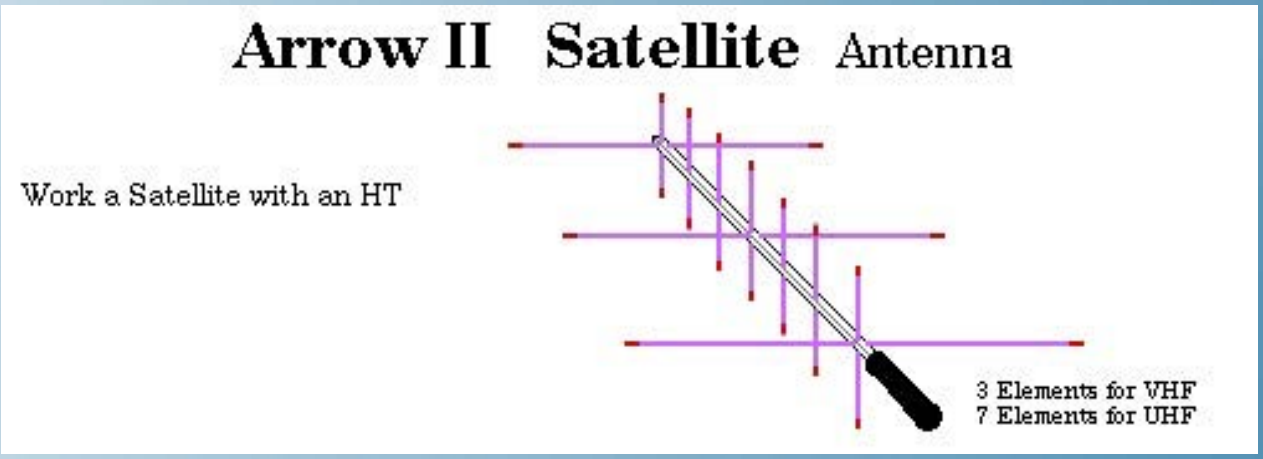
- Yaesu – FT-530
- Kenwood – **TH-D72, TH-D74**
- Icom – IC-W32A

EQUIPMENT - Cheap

2 Cheapo HTs (V & U)

+

Arrow or Elk ANT



EQUIPMENT - Cheap

2 Cheapo HTs (V & U)

+

Homebrew ANT

Club Project Yagi – WA5VJB

EQUIPMENT - Cheap

Cheapo HT (V or U)

+

SDR

+

Homebrew ANT

EQUIPMENT - Cheap

About $60

2 Baofeng (Amazon)

Misc hardware

EQUIPMENT

My station:

Full Duplex HTs FT-530, TH-D72 and FT-1634 (2 x FT-817)

Handheld UHF/VHF antenna

Diplexor, Headset, Digicorder

More stuff:

Headsets

Compass

Splitter + digital recorder (logging)

More hands?

Grid Squares

Maidenhead, UK

Long/Lat in letters/numbers

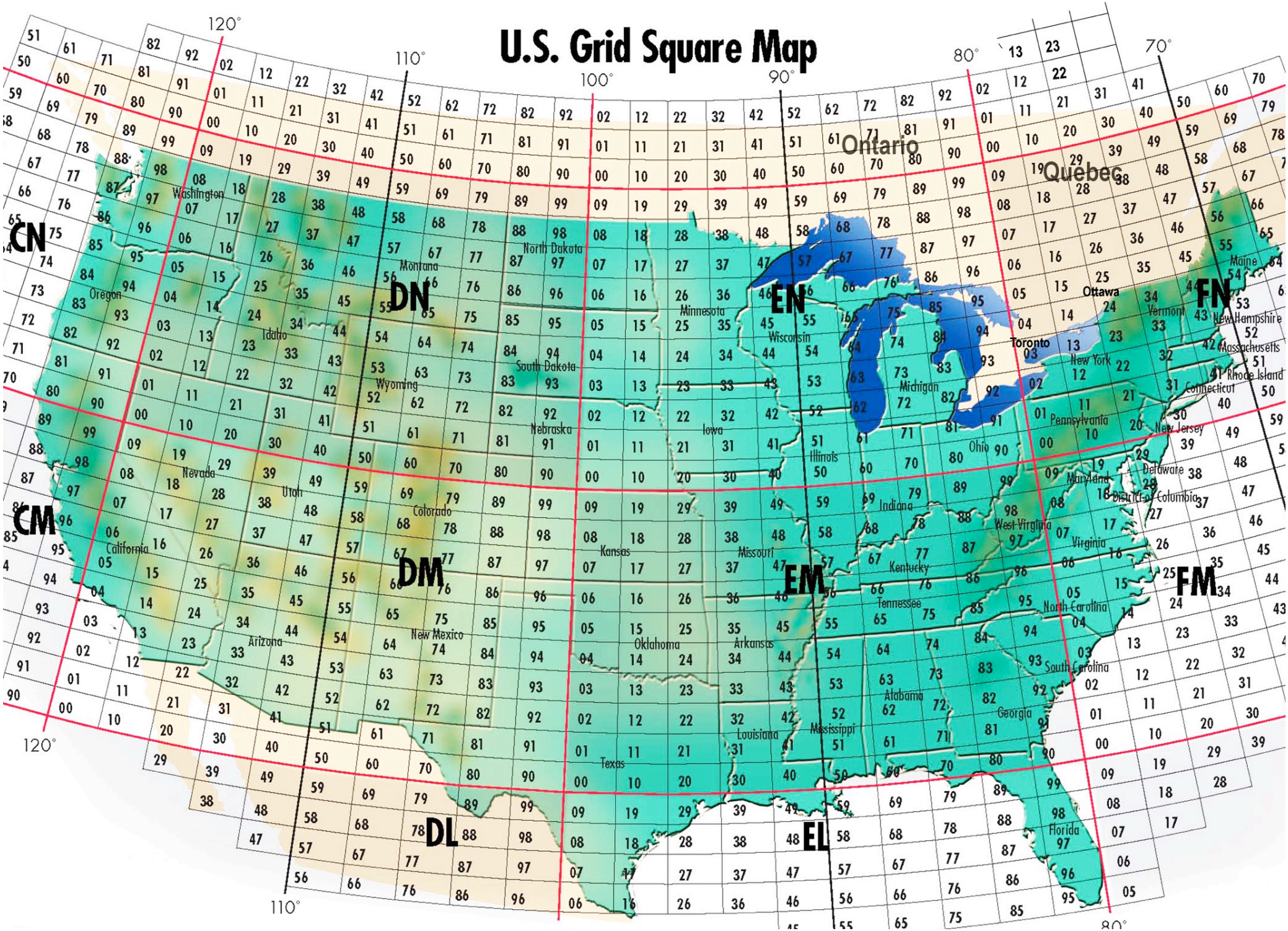
e.g. DM79 (Arapahoe County)

DN71qd39 (Home QTH)

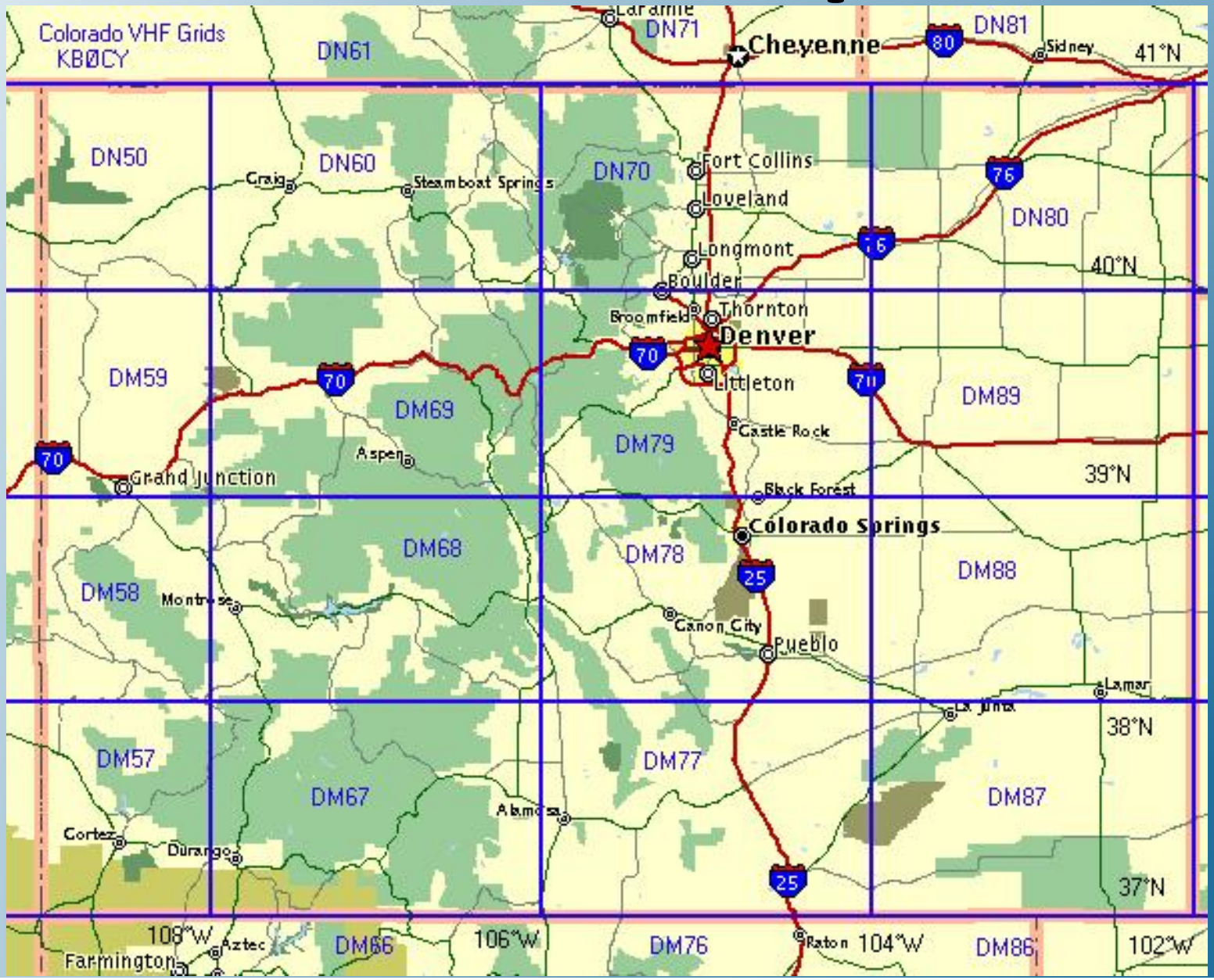
4 character squares are

2˚ Longitude x 1˚ Latitude

U.S. Grid Square Map



Colorado Grid Squares

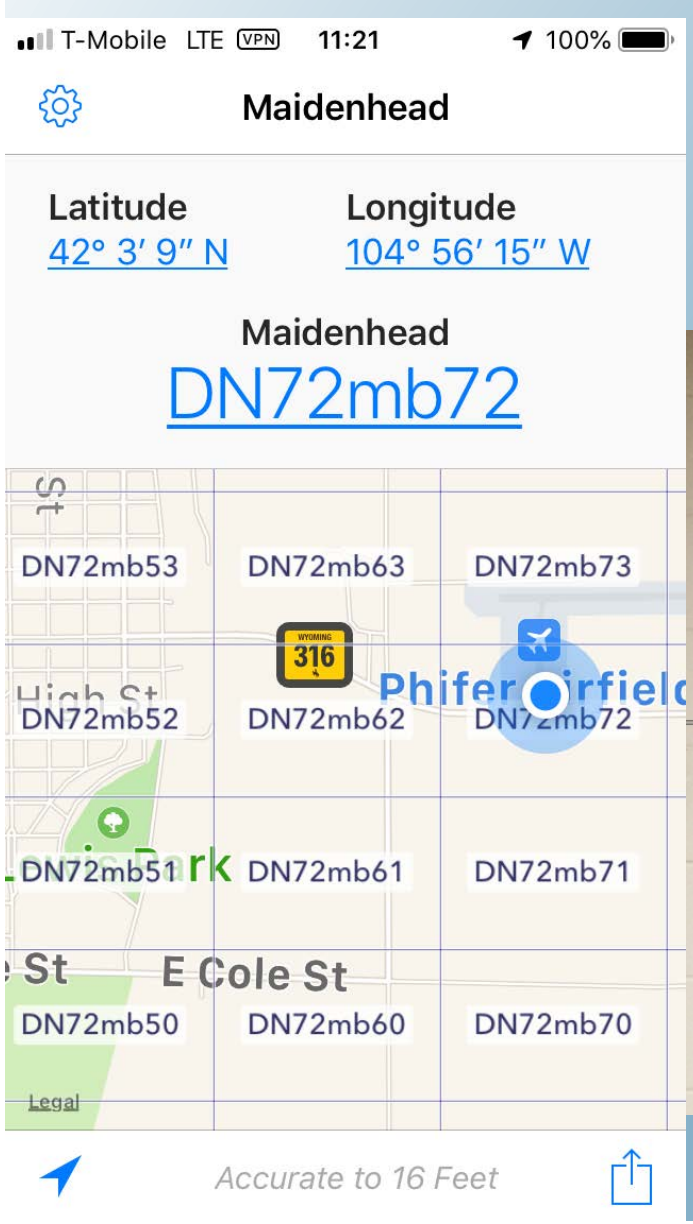


Determining Grid Squares

Software

- Maidenhead (iOS/Android)
- Theodolite (iOS)
- Kenwood TH-D72 (APRS)
- Some GPS (Garmin Nuvi)

Determining Grid Squares



Where to start?

- Find a pass of interest
- Take a listen 2m HT or base
  - 145.960 (AO-91)
  - 145.880 (AO-92)

Programming HT SO-50

	Channel	Tx	Rx	CTCSS
Timer	1	145.845	436.805	74.4 Hz
AOS	2	145.845	436.805	67 Hz
	3	145.845	436.800	67 Hz
	4	145.850	436.795	67 Hz
	5	145.850	436.790	67 Hz
LOS	6	145.850	436.785	67 Hz

Use different channel pairs for Doppler correction

Programming HT FM

Cheat Sheets

KE0PBR Frequency Cheat Sheet

Please use as you see fit, add change or modify.

You can watch "https://ke0pbr.wordpress.com/" for updates and other satellite information.

There is also an Excel download at the above site.

SO-50	67 Hz	
Preset #3	Up (FM)	Down (FM)
AOS	145.845	436.805
2	145.845	436.800
Mid	145.850	436.795
4		436.790
LOS		436.785

AO-91		67 Hz
Preset #2	Up (FM)	Down (FM)
AOS	435.240	145.965
2	435.245	
Mid	435.250	145.960
4	435.255	
LOS	435.260	

LilacSat-2	No tone	
	Up (FM)	Down (FM)
AOS		437.210
2		437.205
Mid	144.350	437.200
4		437.195
LOS		437.190

AO-92		67 Hz
Preset #1	Up (FM)	Down (FM)
AOS	435.340	145.885
2	435.345	
Mid	435.350	145.880
4	435.355	
LOS	435.360	145.875

L-Band	AO-92
AOS	1267.320
	1267.325
	1267.330
	1267.335
	1267.340
	1267.345
TCA	1267.350
	1267.355
	1267.360
	1267.365
	1267.370
	1267.375
LOS	1267.380

<- Doppler is High to Low

Or NOT Programming

Cheat Sheets using VFO mode

XW-2A		Preset #3			Beacon:	145.66
AOS	Up LSB	435.020	435.025	435.030	435.035	435.040
2		435.025	435.030	435.035	435.040	435.045
Mid		435.030	435.035	435.040	435.045	435.050
4		435.035	435.040	435.045	435.050	435.055
LOS		435.040	435.045	435.050	435.055	435.060
VHF	Down USB	145.685	145.680	145.675	145.670	145.665

XW-2B		Preset #4			Beacon:	145.725
AOS	Up LSB	435.080	435.085	435.090	435.095	435.100
2		435.085	435.090	435.095	435.100	435.105
Mid		435.090	435.095	435.100	435.105	435.110
4		435.095	435.100	435.105	435.110	435.115
LOS		435.100	435.105	435.110	435.115	435.120
VHF	Down USB	145.750	145.745	145.740	145.735	145.730

CAS-4A		Preset #8			Beacon:
AOS	Up LSB	435.200	435.205	435.210	435.215
2		435.205	435.210	435.215	435.220
Mid		435.210	435.215	435.220	435.225
4		435.215	435.220	435.225	435.230
LOS		435.220	435.225	435.230	435.235
VHF	Down USB	145.880	145.875	145.870	145.865

XW-2C		Preset #5			Beacon:	145.79
AOS	Up LSB	435.140	435.145	435.150	435.155	435.160
2		435.145	435.150	435.155	435.160	435.165
Mid		435.150	435.155	435.160	435.165	435.170
4		435.155	435.160	435.165	435.170	435.175
LOS		435.160	435.165	435.170	435.175	435.180
VHF	Down USB	145.815	145.810	145.805	145.800	145.795

CAS-4B		Preset #9			Beacon:
AOS	Up LSB	435.260	435.265	435.270	435.275
2		435.265	435.270	435.275	435.280
Mid		435.270	435.275	435.280	435.285
4		435.275	435.280	435.285	435.290
LOS		435.280	435.285	435.290	435.295
VHF	Down USB	145.935	145.930	145.925	145.920

XW-2F		Preset #7			Beacon:	145.795
AOS	Up LSB	435.320	435.325	435.330	435.335	435.340
2		435.325	435.330	435.335	435.340	435.345
Mid		435.330	435.335	435.340	435.345	435.350
4		435.335	435.340	435.345	435.350	435.355
LOS		435.340	435.345	435.350	435.355	435.360
VHF	Down USB	146.000	145.995	145.990	145.985	145.980

AO-73		Preset #0			Beacon:
AOS	Up LSB	435.130	435.135	435.140	435.145
2		435.135	435.140	435.145	435.150
Mid		435.140	435.145	435.150	435.155
4		435.145	435.150	435.155	435.160
LOS		435.150	435.155	435.160	435.165
VHF	Down USB	145.970	145.965	145.960	145.955

Normal HAM procedures

Except QSO is “short” (FP)

Use a satellite exchange:

- Callsigns, 5x9 <grid square>
- QSL, my callsign

Sat HAM etiquette

Don’t overload satellite Rx

- Distorts downlink
- 5-10 W adequate for 59
- AO-7 power causes flipping

Few “pile-ups”

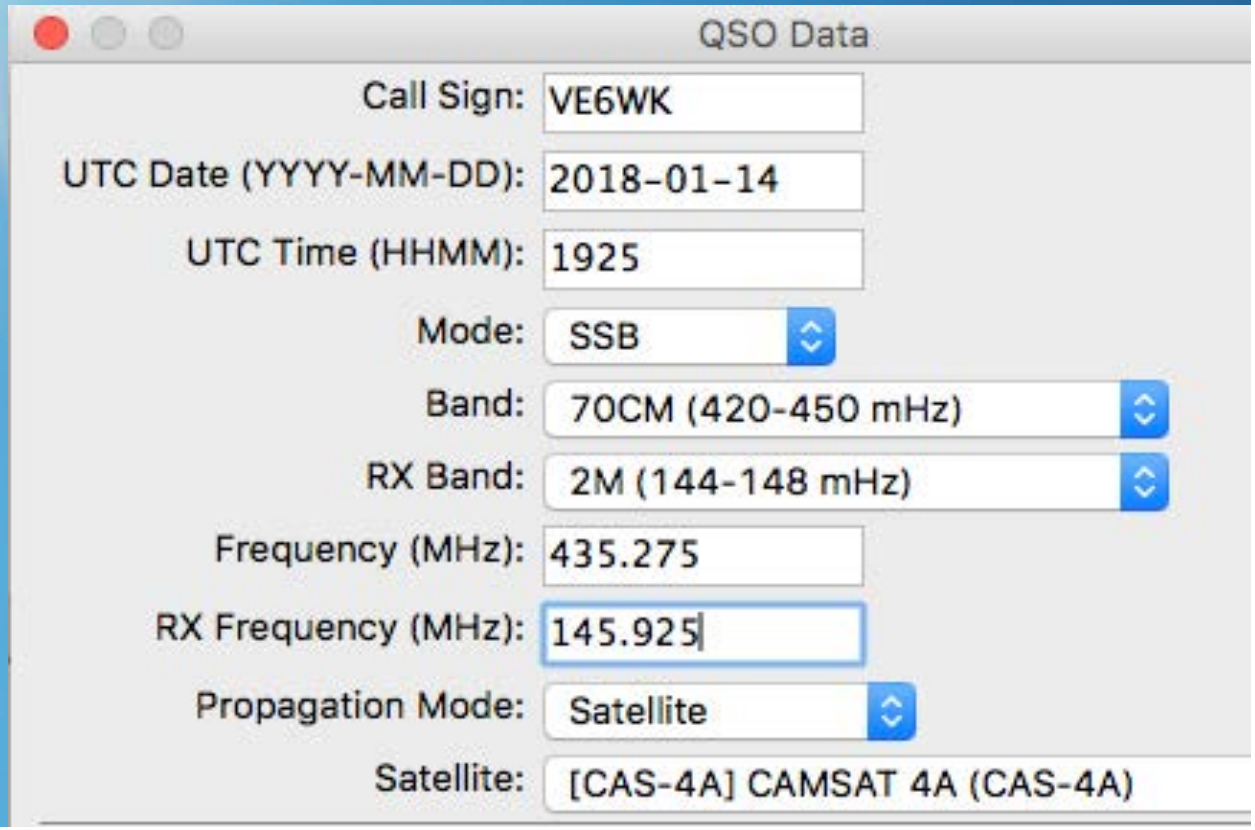
- Considerate to Rovers, Special Events

You are ready

But – what does an exchange ‘sound’ like?

QSO

QSL via LotW (tQSL)



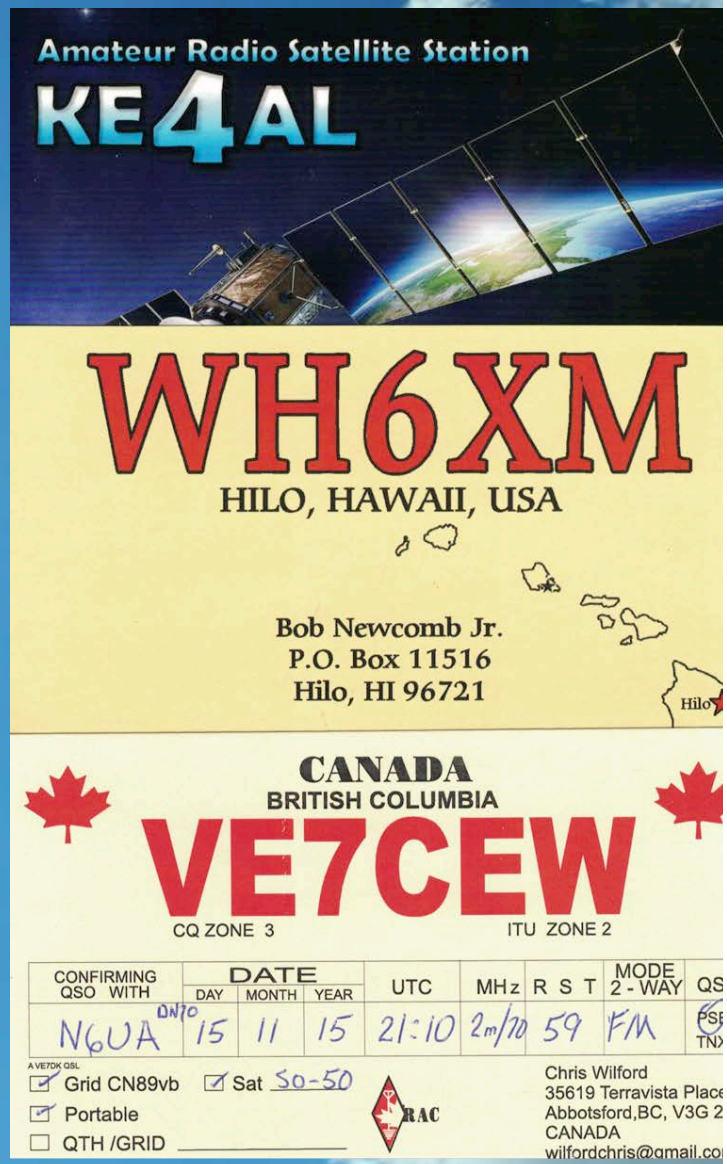
QSO

QSL via LotW

	Call sign	Worked	Date/Time	Band	Mode	Freq	QSL		VUCC
Details	N6UA	KE9AJ	2018-01-14 20:33:00	Sat	SSB	435.28000	UNITED STATES OF AMERICA	*	**EN50:** VUCC Satellite
Details	N6UA	K5ND	2018-01-14 20:33:00	Sat	SSB	435.28000	UNITED STATES OF AMERICA	*	**EM12:** VUCC Satellite
Details	N6UA	VE7CEW	2018-01-14 20:33:00	Sat	SSB	435.28000	CANADA	*	**CN89:** VUCC Satellite
Details	N6UA	WD9EWK	2018-01-14 19:21:00	Sat	FM	435.25000	UNITED STATES OF AMERICA	*	**DM43:** VUCC Satellite

QSO

QSL the old way



Awards!

DXCC

- Possible with current constellation: K8YSE

WAS

- Hawaii tough, some states have few active Satellite Ops

VUCC (VHF/UHF Century Club)

- 488 Grid Squares in Lower 48 CONUS
- Roughly "Satellite DXCC"

AMSAT Awards (VUCC/r, OSCAR CC)

Distance Records

Awards!

Your Logbook DXCC Account (N6UA - UNITED STATES

Account Status

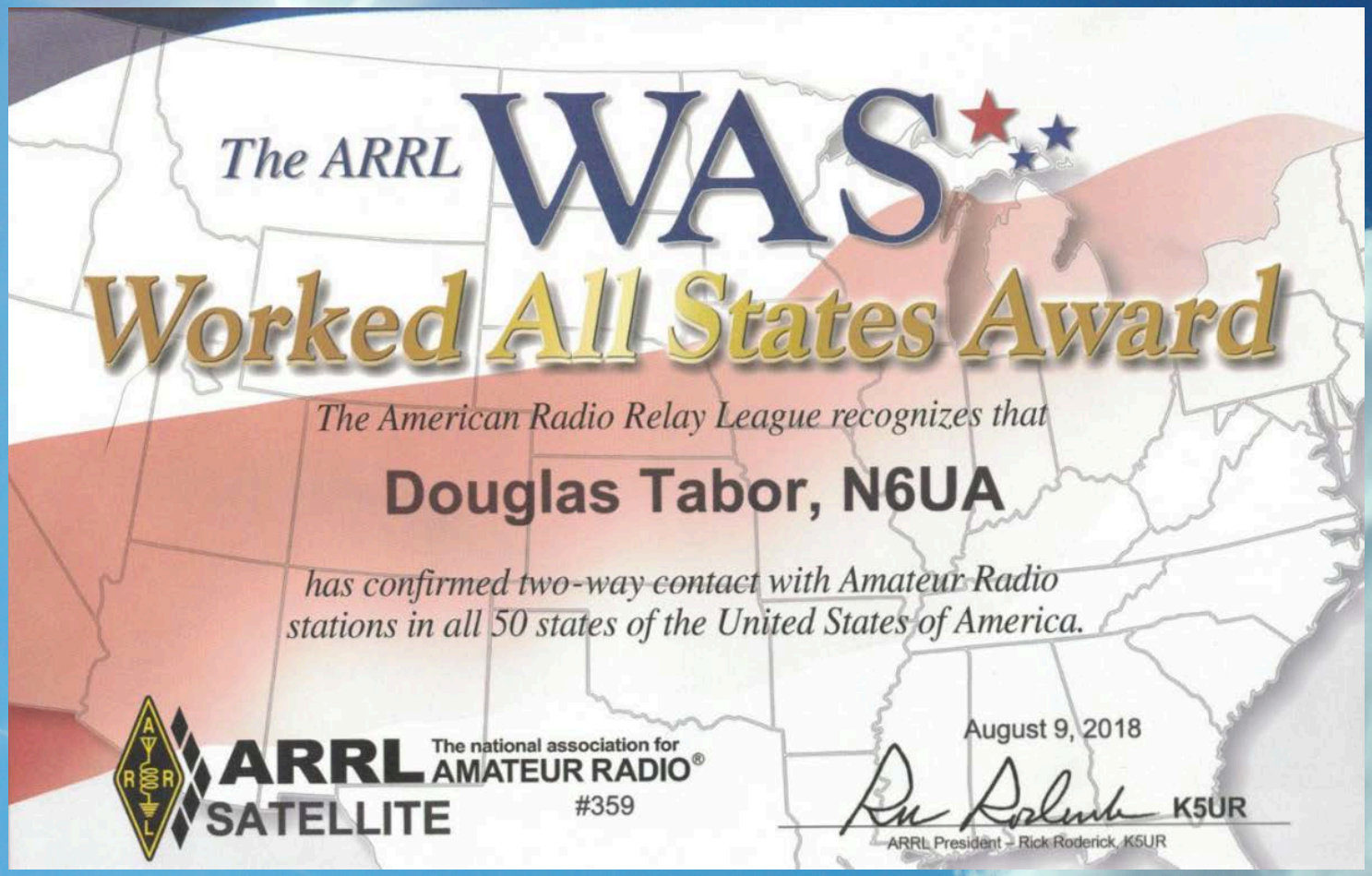
DXCC Award	New LoTW QSLs	LoTW QSLs in Process	DXCC Credits Awarded	Total (All)	Total (Current)
Mixed	60	0	0	60	60
CW	5	0	0	5	5
Phone	58	0	0	58	58
Satellite	21	0	0	21	21

Your Logbook VUCC Account (N6UA VUCC)

Account Status

VUCC Award	New LoTW QSLs	LoTW QSLs in Process	VUCC Credits Awarded	Total
Fred Fish Memorial Award	31	0	0	31
VUCC 50 MHz	33	0	0	33
VUCC 144 MHz	2	0	0	2
VUCC Satellite	427	0	0	427

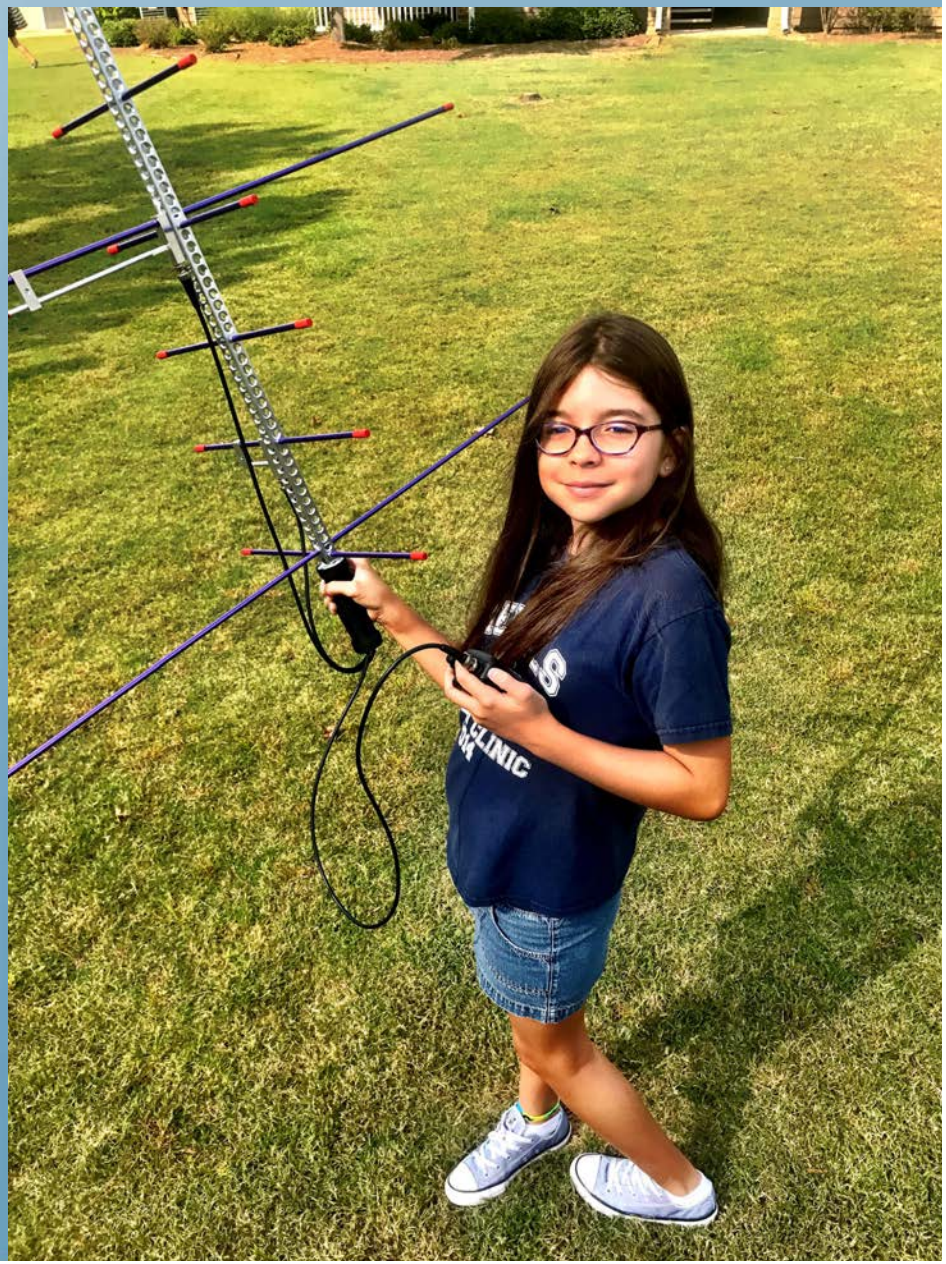
Awards!


The ARRL WAS
Worked All States Award
The American Radio Relay League recognizes that
Douglas Tabor, N6UA
has confirmed two-way contact with Amateur Radio
stations in all 50 states of the United States of America.
ARRL SATELLITE
The national association for AMATEUR RADIO®
#359
August 9, 2018
K5UR
ARRL President - Rick Roderick, K5UR

Not just for old hams!

W4AQT

Alabama



MORE INFO

amsat.org

G6LVB.com

PE0SAT

www.work-sat.com

YouTube, Periscope or Twitter

Local Elmers n6ua@amsat.org

Break Time

Roving

DN61 rover – I-80 E Wamsutter, WY
AMSAT pass prediction on dash
Smart XYL, K0ZXZ in warm car

Motorcycle Rover

N6UA rover in NW Kansas (DM99/DN90)

Rover Checklist

Radios - charged
Antenna(s)
Headphones + breakout, spare earbuds
Digital recorder - charged
Clipboard - pens
Frequency charts
spare cables + connectors (audio/RF)
SLA charged + power cables
car inverter - outlet strip – chargers
phone - charging cable - plug-in charger - solar/LiON pack
iPad/computer - charging cable/power module – latest data loaded
electronics tool kit
maps
headlamp + flashlights

DM36 rover – Grand Canyon, AZ

Fernando Ramirez-Ferrer

N6UA Roving in 2018

Ham Radio in the

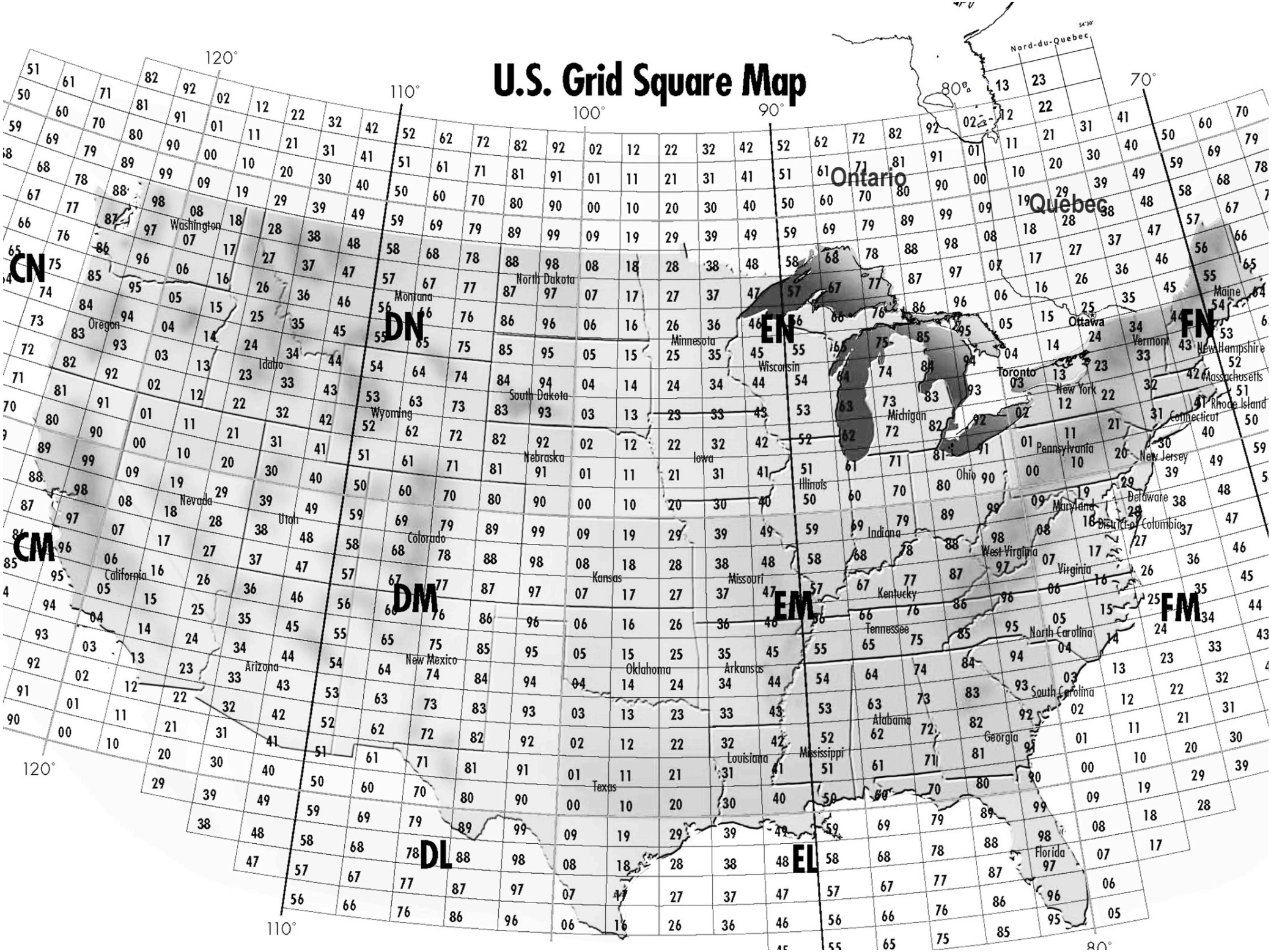
Great Outdoors

Exercise

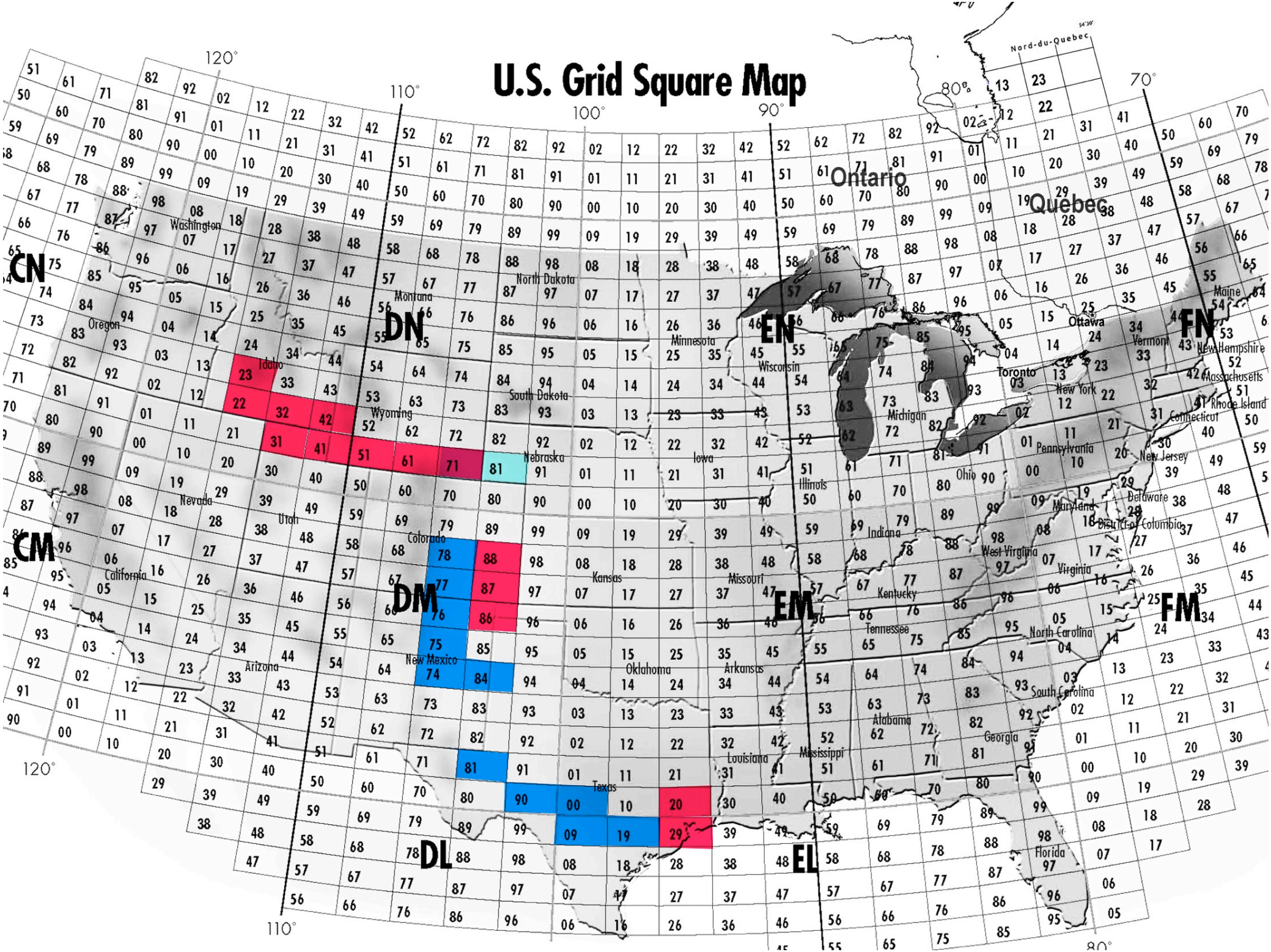
Camaraderie

VUCC awards

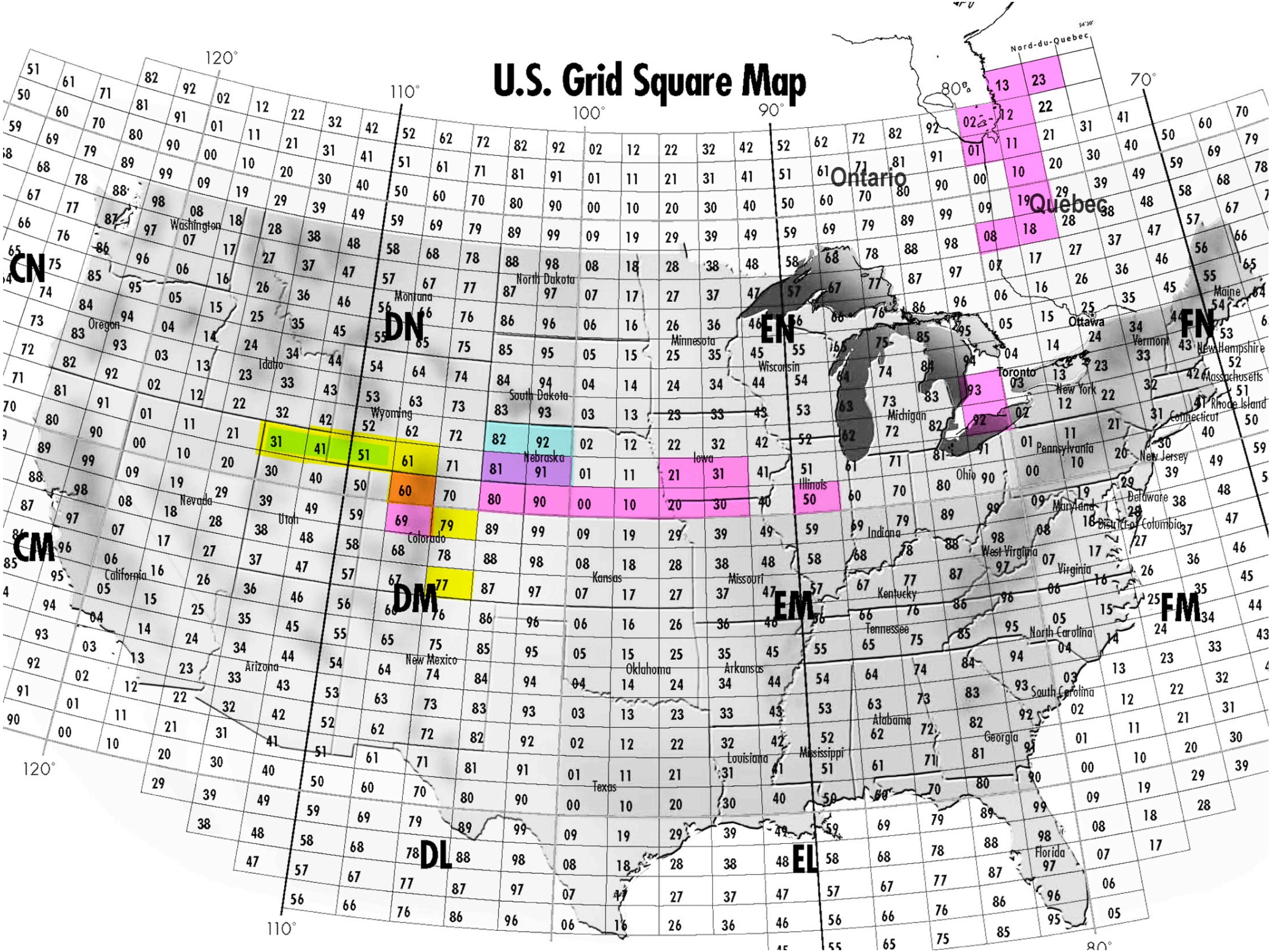
U.S. Grid Square Map



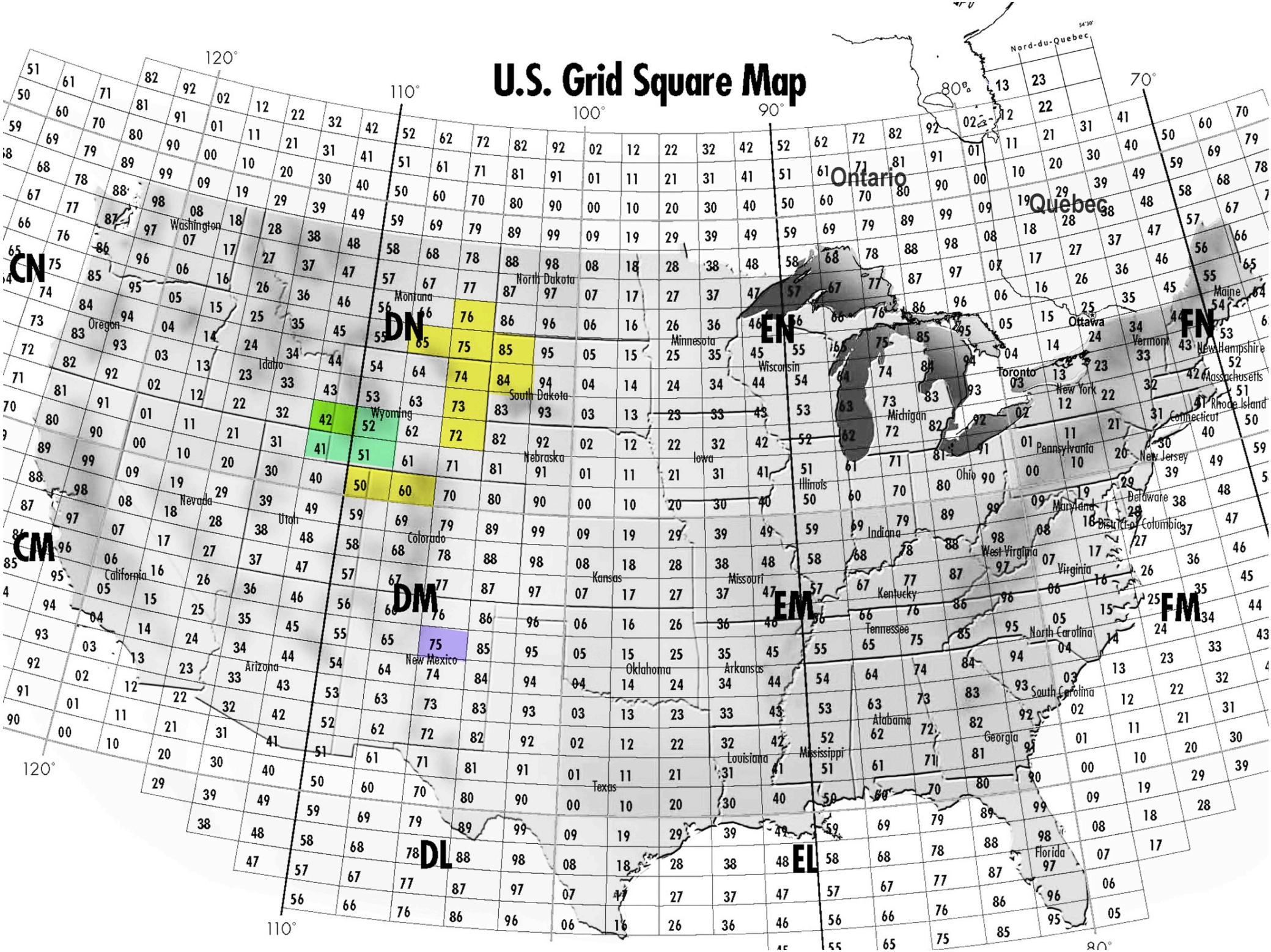
U.S. Grid Square Map



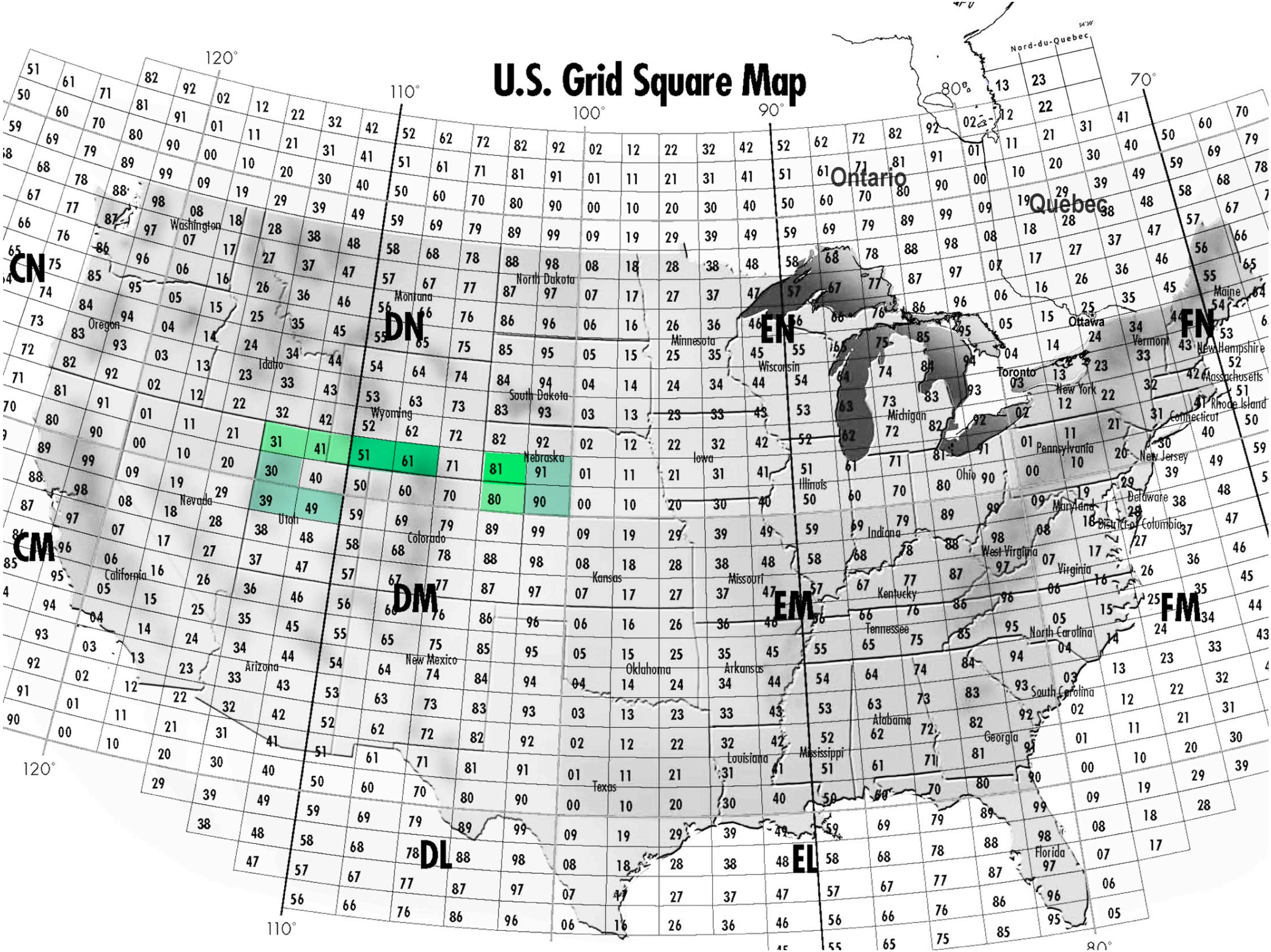
U.S. Grid Square Map



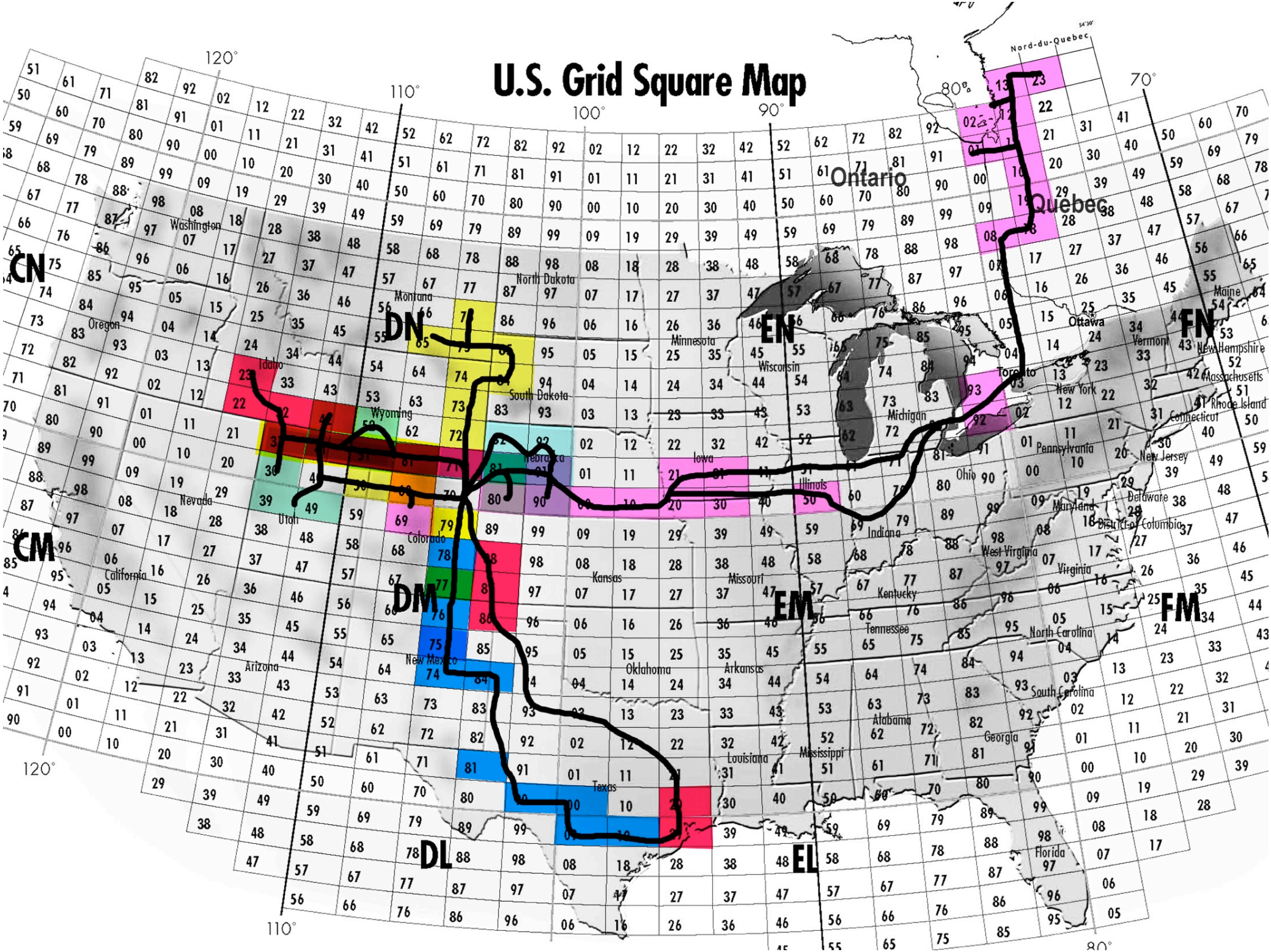
U.S. Grid Square Map



U.S. Grid Square Map



U.S. Grid Square Map



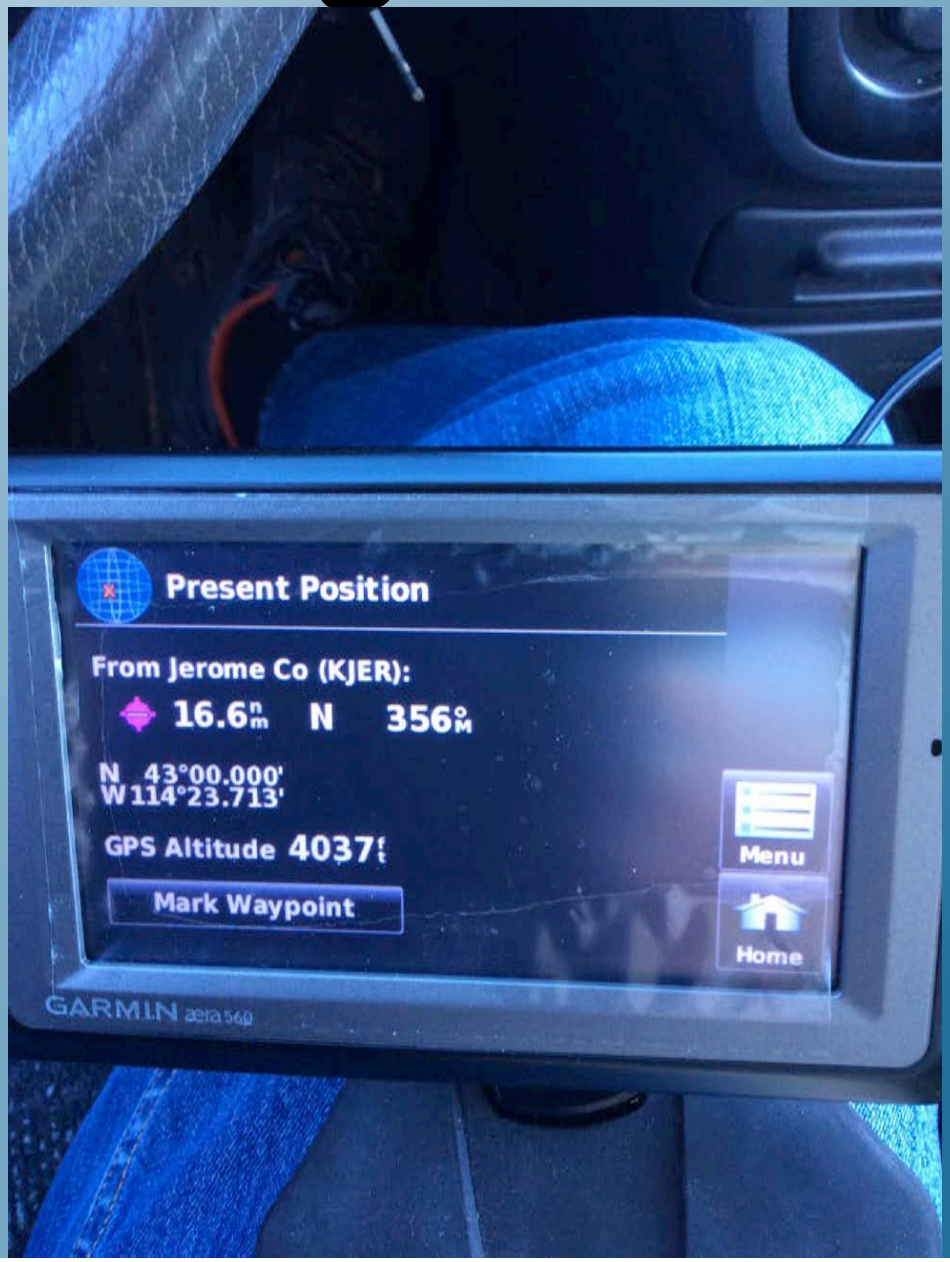
N6UA Roving in 2018

DN31/DN41
Line
Near
Great Salt Lake

N6UA Roving in 2018

DN22/DN23
Line
Idaho

488 for N8RO



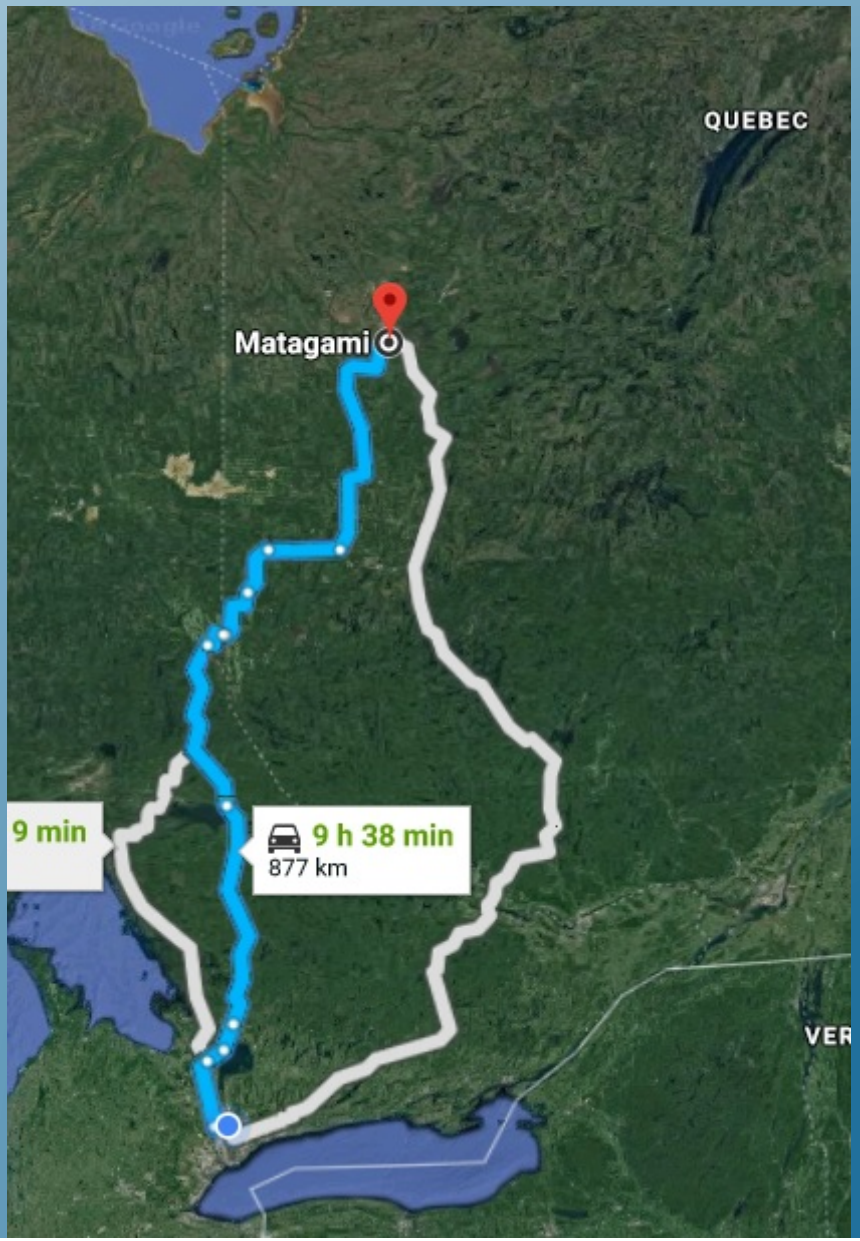
N6UA Roving in 2018

Highlights

3 Mar –	Pine Bluffs, WY – MI6GTY
21 Mar –	N6UA/ZL – RF73 – ZL3GAV
2 May –	FO-pedition CO to QC – VE3HLS
11 Apr –	Cache County, UT – MI6GTY
14 Jun –	Sand Hills, NE DN 81/82/91/92
2 July –	K7TAB WMPLOTA/SD/WY/MT
10 Aug –	Raton, NM – MI6GTY
15 Dec –	Ogallala, NE – WY7AA

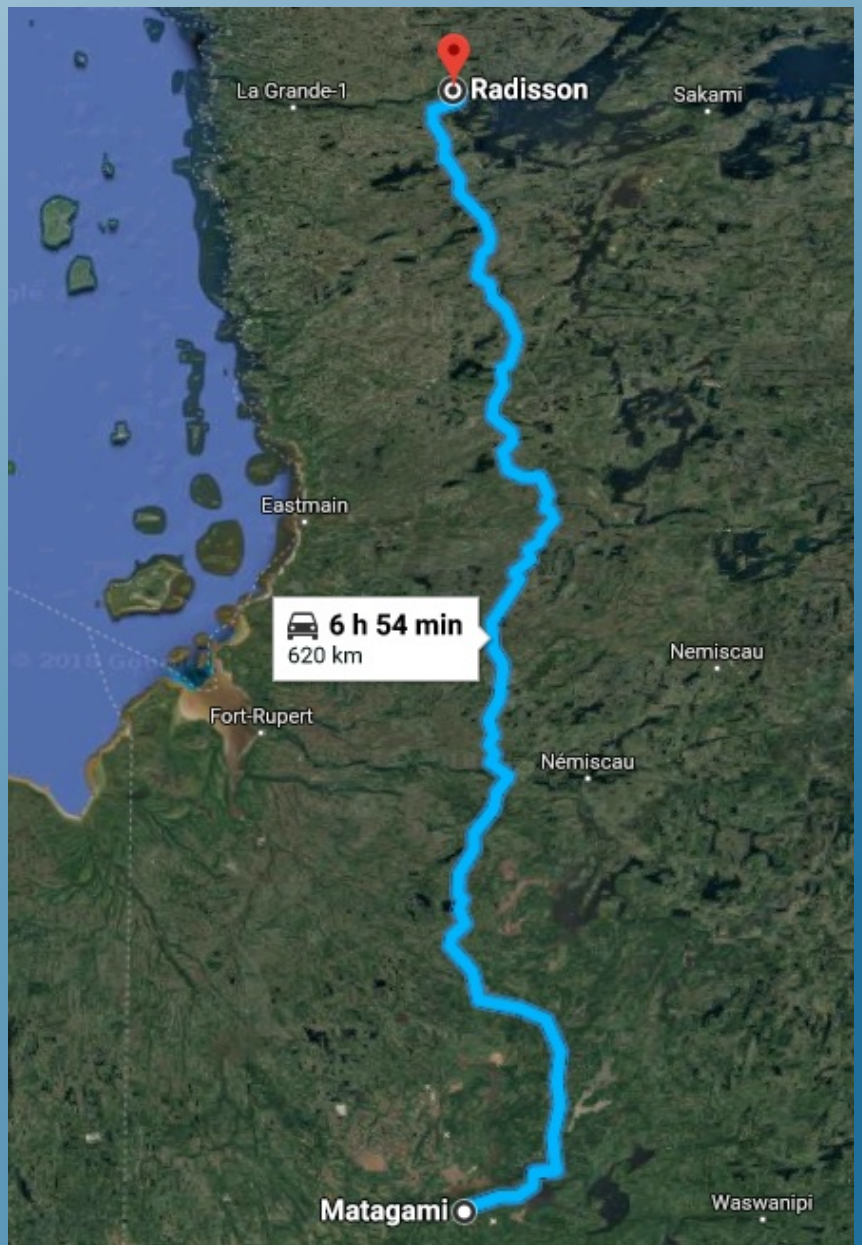
N6UA Roving in 2018

FO-pedition in Quebec
10 hours Toronto
to Matagami after
1.5 days Colorado to
Ontario



N6UA Roving in 2018

FO-pedition in Quebec
7 hours Matagami to
Radisson, QC 53˚ N



N6UA/VE2 Roving in 2018

FN19
Matagami, QC
May 15th

N6UA/VE2 Roving in 2018

FO11/FO12
James Bay
Hwy, QC

N6UA/VE2 Roving in 2018

FO02/FO03
Wemindji, QC

N6UA/VE2 Roving in 2018

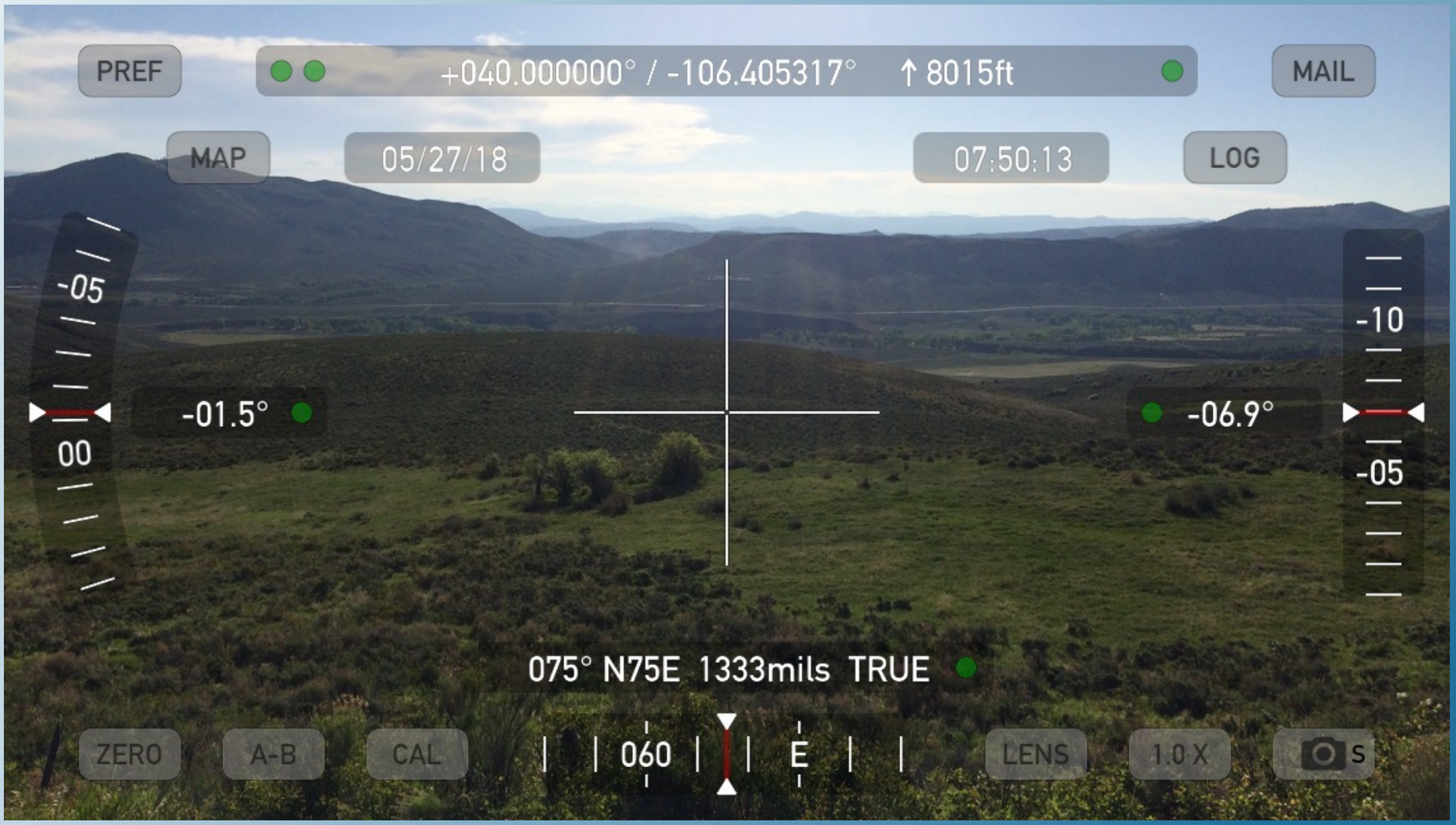
FO01
Waskaganish,
QC

N6UA Roving in 2018

DN31/DN41
Riverdale,
Utah

WMPLOTA

N6UA Roving in 2018



DN60/DM69 Line – Grand County

N6UA Roving in 2018

DN75/DN76
MT, Line

K7TAB, Chris

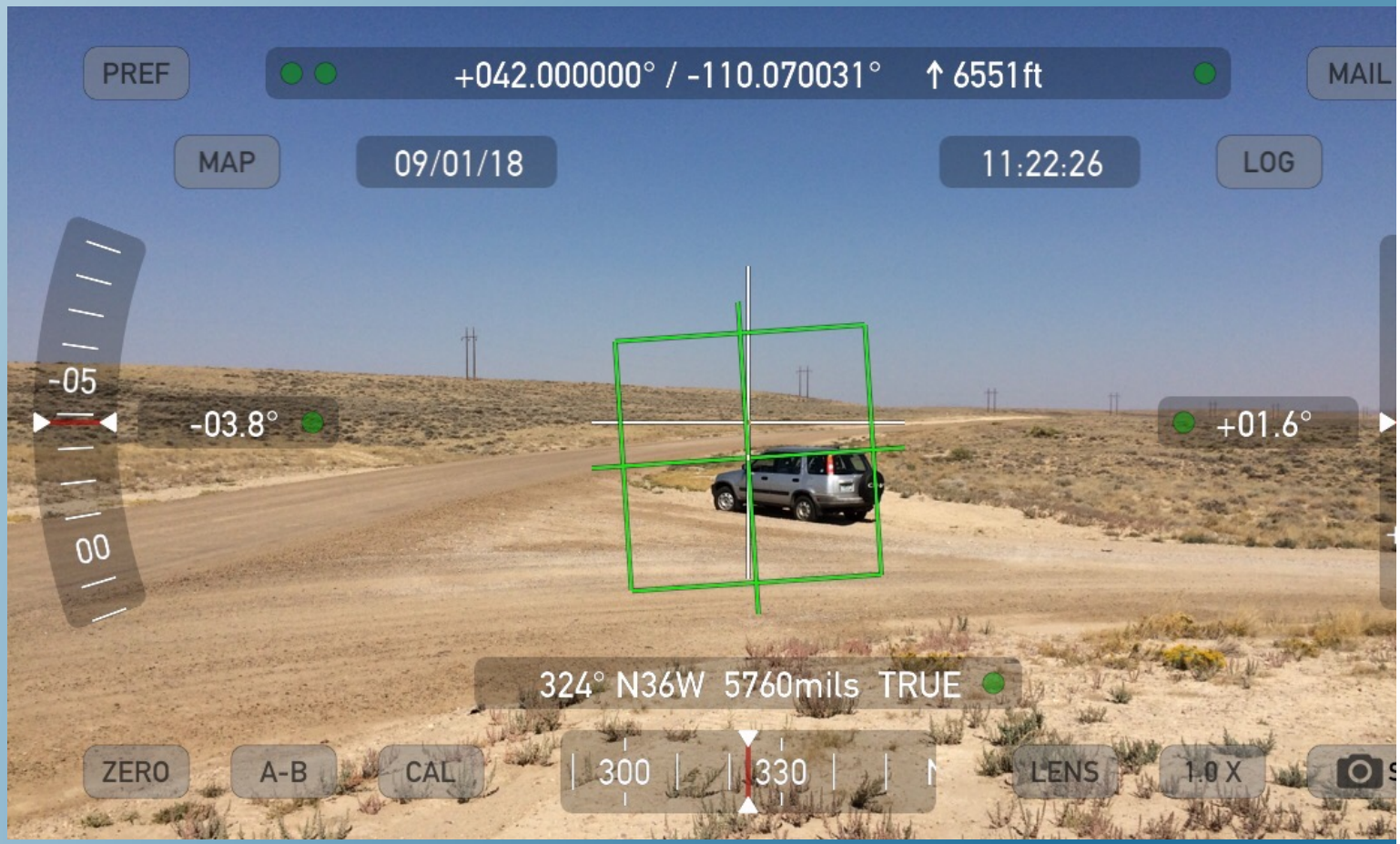
N6UA Roving in 2018

SOTA & SATS
DN70
Deer Mtn
RMNP

Joe, KE9AJ
Chris, K7TAB

N6UA Roving in 2018

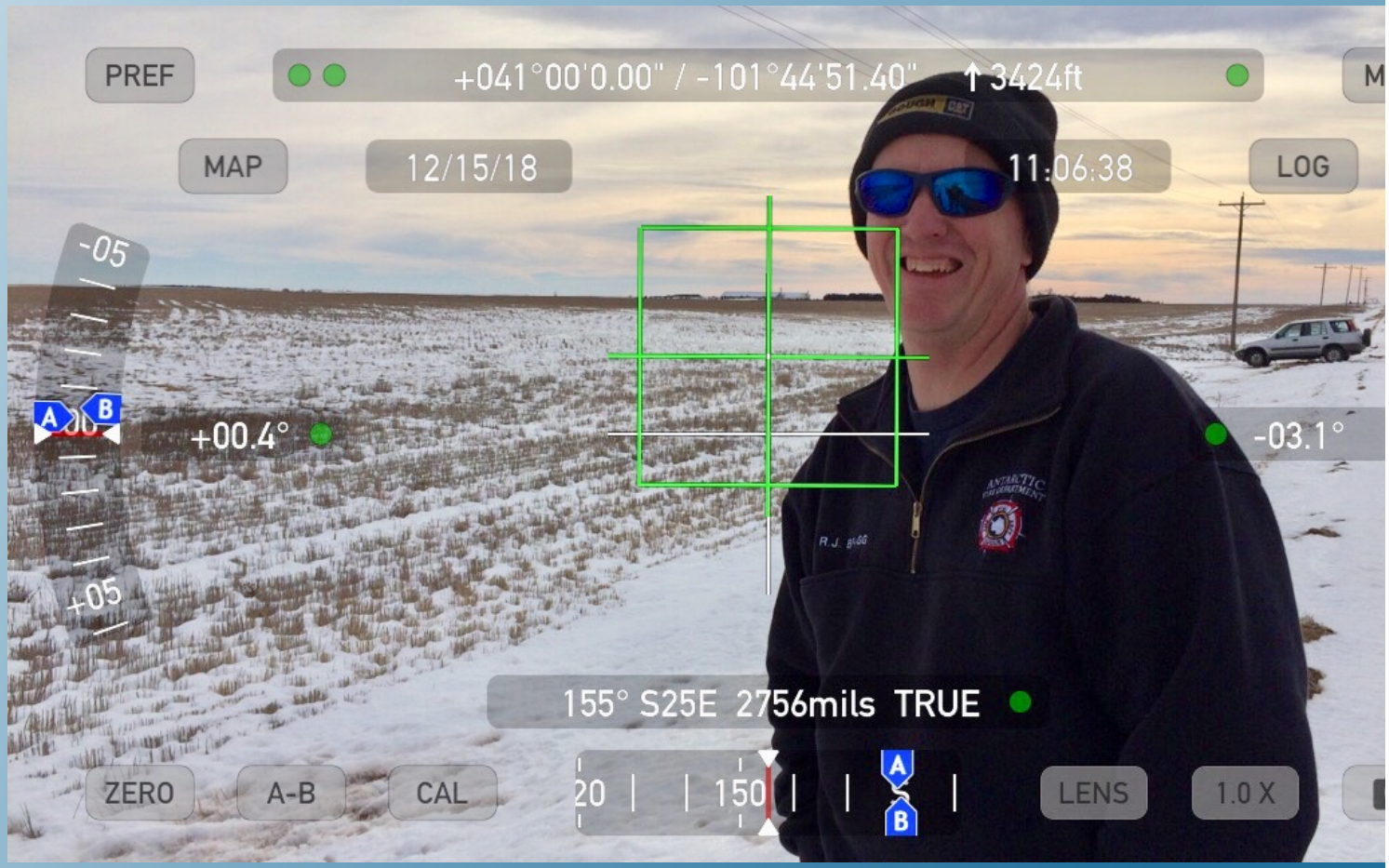
DN41/DN42
Fontenelle, WY



N6UA Roving in 2018

DN90/DN91
Ogallala, NE

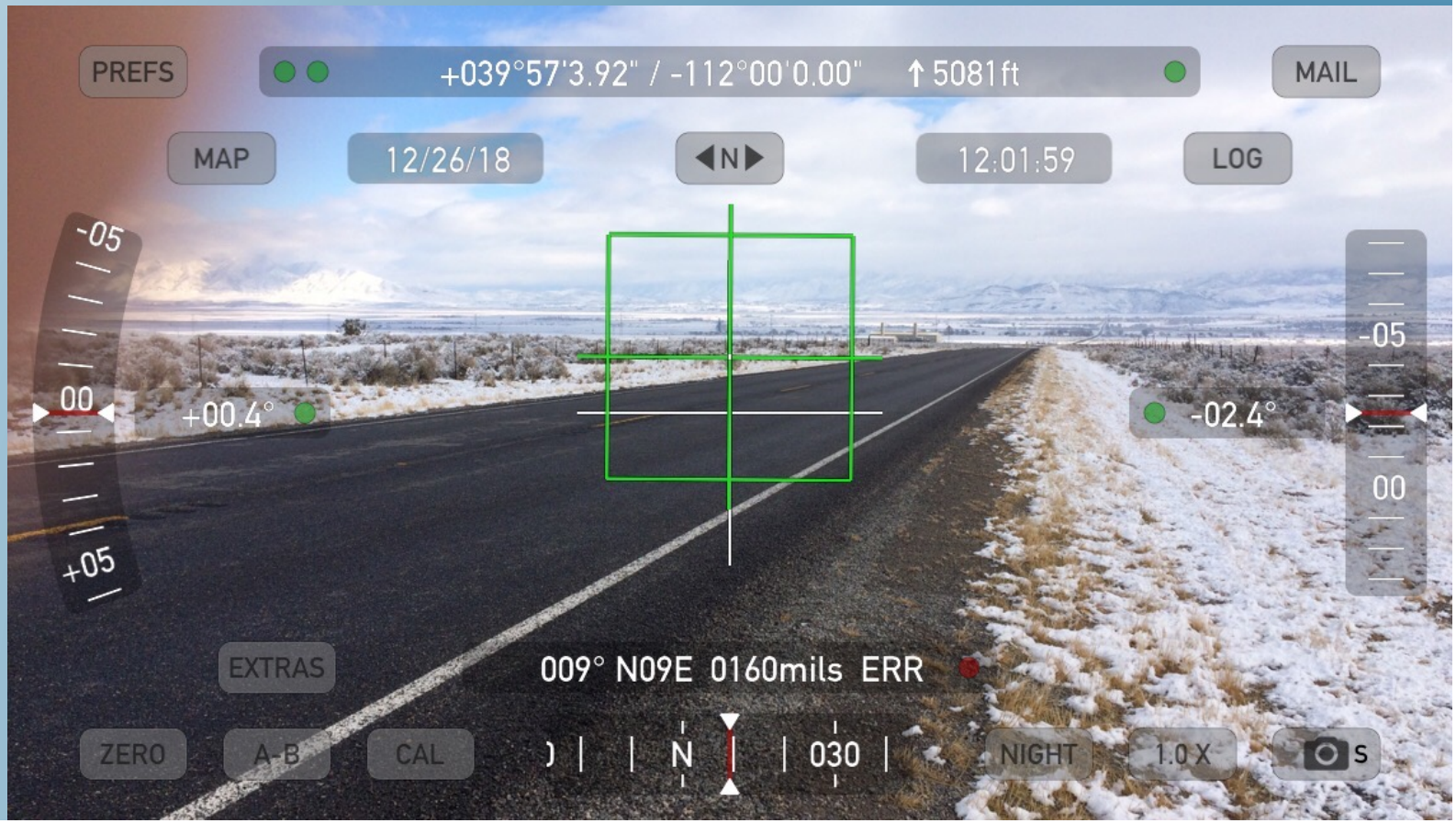
WY7AA, RJ



N6UA Roving in 2018

DM39/DM49

W Goshen, UT – Last rove of 2018



Possible Demo

AO-91 @ 1845z (W)

CAS-4B @ 1858z (S)

Q & A

73 & TNX for your time
de N6UA