Owning Low Earth Orbit

Beginner to Advance Satellite Operating

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Disclaimer

My Journey, My Opinions, My Operating Goals, My Skillset

Everyone is different, my way is not the right way for you. I'm not an expert, but do have consistent success. Take what you want from this presentation, ask questions now or contact me later…
Shelve this presentation or have a go at working Sats. It can be very rewarding in many aspects (ie VHF+ DX!!).

Repeaters in the sky!

- Just like a Repeater we transmit on one frequency and listen on another
- Unlike most repeaters satellites are cross band (eliminates the need for a heavy duplexer)
  - Mode U/V (We transmit on UHF, Listen on VHF) ✔
  - Mode V/U (We transmit on VHF, Listen on UHF) (SO50)
- Just like a repeater some use CTCSS tone on TX (67.0 Hz)
- Full Duplex is best (listen while you talk)
  - Full Duplex Radio (Like Kenwood TH-D72A)
  - Use Two HT’s (one on RX, one on TX)
- Line of Site! Just not in a 2D plane, sometimes close as 250 miles

Repeaters in the sky!

Today there are FOUR Easy FM Voice Satellites

- SO-50 (SaudiSat, Dec 2002)
- ISS Crossband (Sep 2020)
- LilacSAT-2
- AO-91 (Fox1B, Nov 2017)
- AO-92 (Fox1D, Jan 2018)
- AO-27 (Sep 1993 – back from the dead!!)

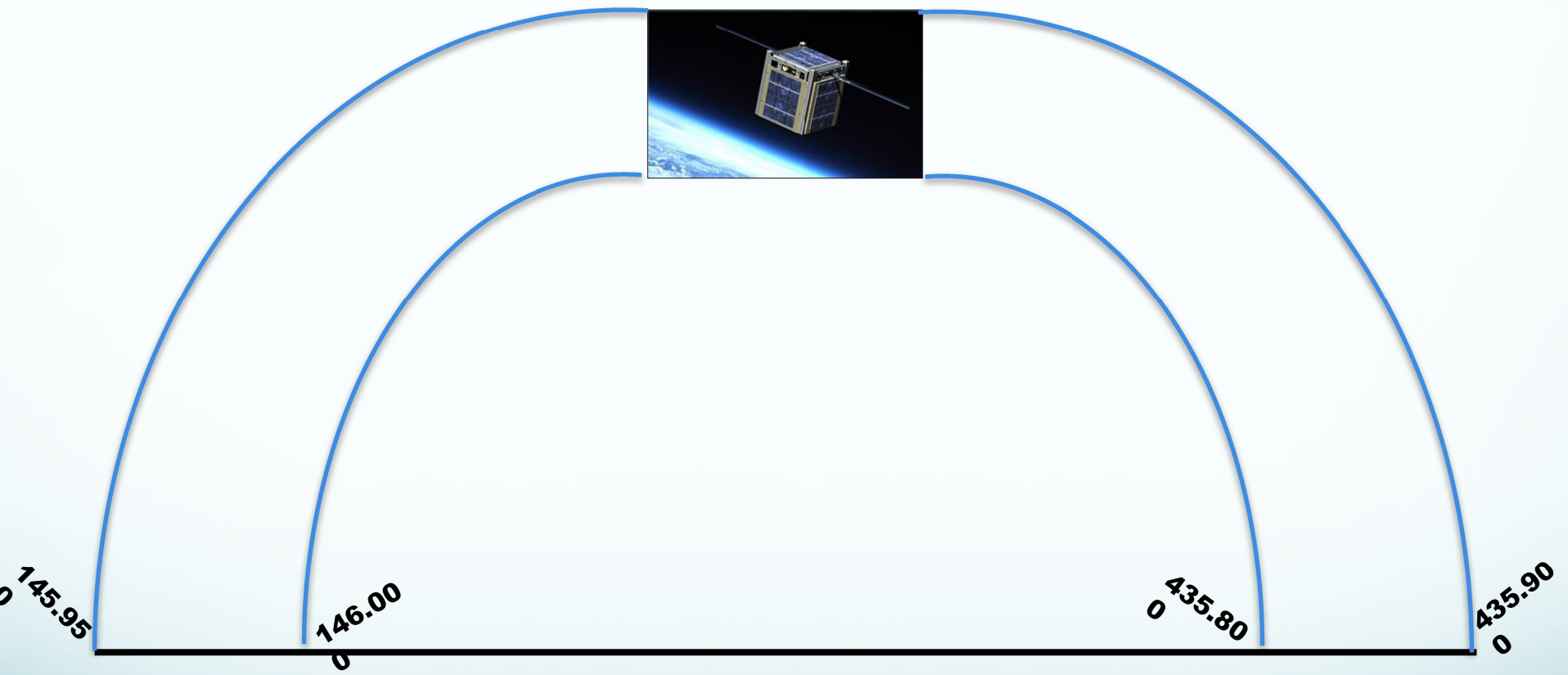
- One Freq allocation up and One Down
  (Think of simplex QSO – only 1 station has the freq)
- QSOs fast and frantic, usually just callsign and grid

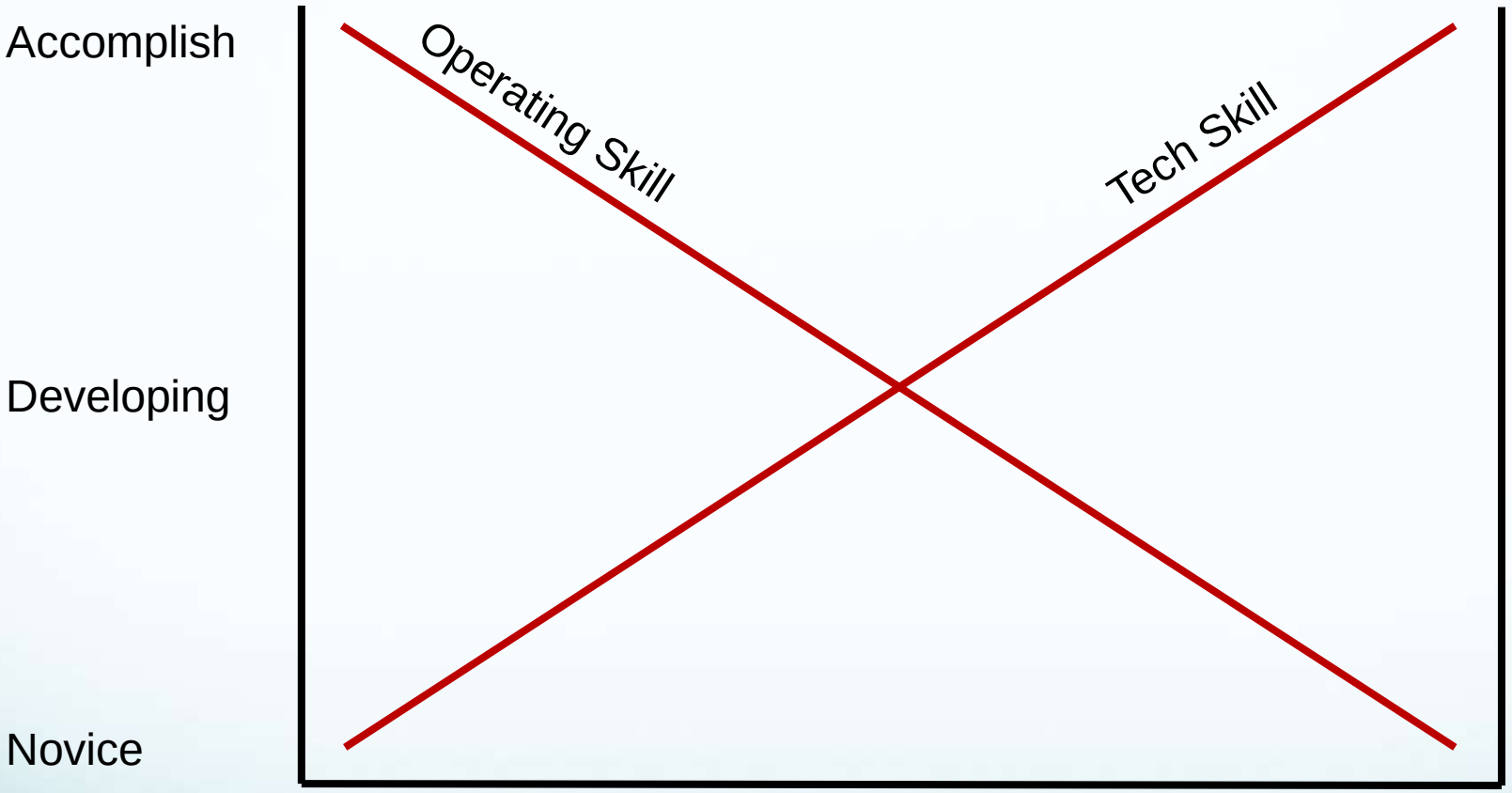
Repeaters in the sky!

Many Linear Birds

- CAS-3C, AO-7, CAS-4A, CAS-4B
- **FO-29 100kHz**
- **RS-44 60kHz**

- Larger bandwidth (20khz to 100khz)
- Many QSOs at 1 time (You can be fast or have a civilized conversation)
- Parts of the band reserved for CW or Data
- You need to find yourself before making a QSOs!!!


145.95
0
146.00
0
435.80
0
435.90
0
Up Link LSB
Downlink USB


Accomplish
Developing
Novice
Operating Skill
Tech Skill
Simple Station
Complex Station
Quick QSOs
Conversations / Digital

Factors For Successful QSOs

- Decide a bird to work, get pass info (time, Az, El)
- Up/Down solution (full duplex, two radios, 1 radio and SDR)
- Deal with Doppler (computer or preset mem channels)
- Deal with moving satellite (3 min stationary, Omni, AzEl tracking, manual tracking)
- Logging solution (your memory, write down, record)

Decide a bird to Work

- Use Online Prediction Services
  - http://www.N2YO.com
  - http://www.amsat.org/track/index.php
- Use Smartphone Tools (SatSat on iPhone)
  - ISS Detector Android App (link in appendix)
- Use Installed PC tools
  - GPREDICT (Windows, Linux)
  - MacDoppler

Simple Stations

NULL

Operating FM Satellites
Phone Mode Only

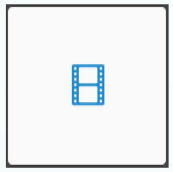
Beast Stations

FM / Linear Satellites
Voice, FT4, CW, APRS
Rcv SSTV images
Message Boards

Ic-9700
Computer for Rig and Rotator control
LMR-400 to antenna
Mast Mounted Pre-Amps
Circularly polarized 70cm and 2m Antennas

What is Doppler?

- Perceived Frequency Shift because the Satellite is moving relative to us on the ground
  - Big deal on 70 cm (+/- 10 KHz) must adjust
  - Not as bad on 2 m (+/- 3 KHz) can ignore



As Satellite **approaches** us the frequency is **higher**

As Satellite **moves away** from us the frequency is **lower**

What to do about Doppler?

All adjustments are made from the ground

- We must adjust our UHF frequency
- We ignore our VHF frequency (FM “Capture”)
- All working FM Sats in Appendix

Typical Channel Programming for AO-92

Channel (When)	RX Frequency	TX Frequency
1 AOS (Start)	145.880	435.340
2 AOS+2 min	145.880	435.345
3 MID Pass	145.880	435.350
4 LOS -2 min	145.880	435.355
5 LOS (End)	145.880	435.360

Basic Contact Plan (FM)

- Do pass predictions for times of rise, mid-pass, set
- Plan where in sky that will be (True North is 14 degrees CW from Magnetic North in RI)
- Select proper memory channel for AOS
- “This is Whisky One Sierra Echo Alpha, W1SEA, in Fox Nancy Forty”
-

Contact Plan Part 2

- Adjust the UHF frequency (usually uplink) during the pass (AOS, +2 min, +4 min, +8 min, +10 min)
- Move your antenna for max signal as satellite moves across the sky
- Log your contacts and upload to LOTW!

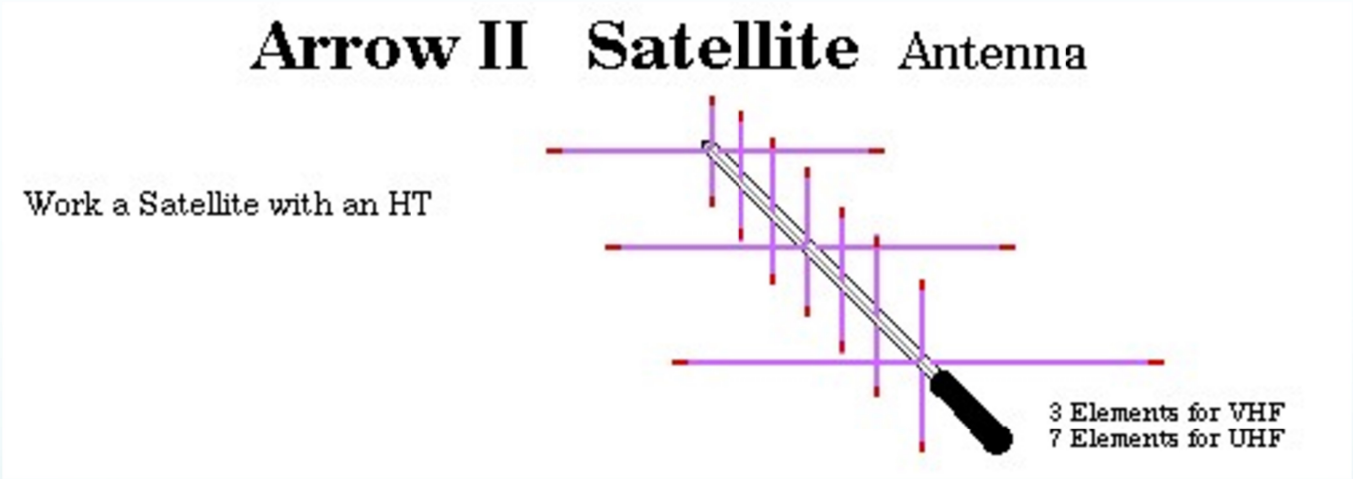
Keep contacts short!! (Allow others time)

Basic Contact Plan (Linear)

- Basically all the same steps, however, once you hear chatter or the beacon, you will need to adjust your RIT on your downlink to matchup with you up link.
-

Gear (Basic)

Antenna Crossed 2m/70cm Beam:
www.arrowantennas.com/arrowii/146-437.html



Other choices: Elk Antenna, Homebrew

Gear (Basic)

- Dual Band Full Duplex (only one in production is Kenwood TH-D72A – TH-D74A is NOT)
- Two HTs (one for 2m another for 70cm - $25 BaoFengs will work)
-

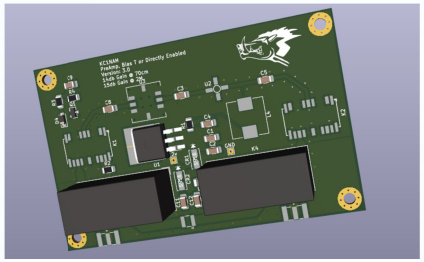
Lots of USED HTs with full duplex

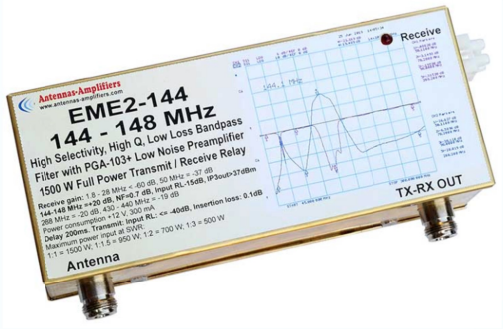
Icom IC-W31A, IC-W32A, IC-W31A Kenwood TH-D7, TH-77, TH-78, TH-79A Yaesu FT-470, FT-589, FR-51R

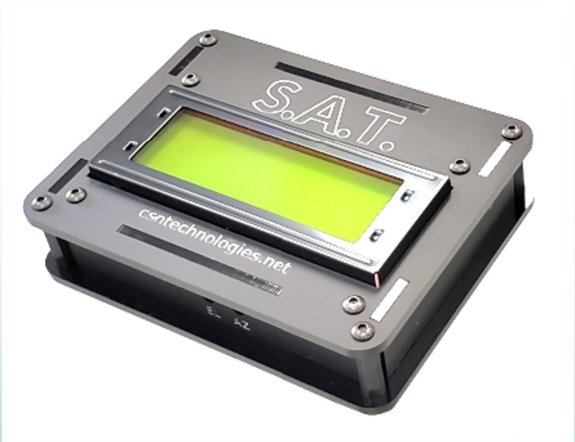
Gear (Advanced - Rigs)

Gear (Advanced – Antenna Systems)

Gear (Advanced – Misc)







Lazy Man's Approach

Put your beam on a camera tripod and point it at the mid-pass Az/El.

Set your rig to the Satellite TX/RX frequency (No Doppler adjustment)

Wait for the satellite to find you

FM Passes – Basic gear

Linear Pass – Advanced gear

Appendix

- Best Book – AMSAT published “Getting Started with Amateur Satellites” (it goes in an out of print. Sometimes you can get the out of print ones at Ham Fests.. Usually $20)
- Frequency List
  - https://www.amsat.org/fm-satellite-frequency-summary/
  - Amateur Radio Satellite (fg8oj.com)
  - Linear Satellite Frequency Summary – AMSAT
  - Communications Satellites – AMSAT
- FM Satellite Info page
  - http://www.work-sat.com/Home.html
- Satellite Status Page
  - https://www.amsat.org/status/
  - https://www.ariss.org/current-status-of-iss-stations.html
  - https://play.google.com/store/apps/details?id=com.runar.issdetector&hl=en_US&gl=US
- AMSAT UK (good website)
  - https://amsat-uk.org/

FM Birds Programming

Typical Channel Programming for ISS

Channel (When)	RX Frequency	TX Frequency
1 AOS (Start)	437.790	145.990 PL 67
2 AOS+2 min	437.795	145.990 PL 67
3 MID Pass	437.800	145.990 PL 67
4 LOS -2 min	437.805	145.990 PL 67
5 LOS (End)	437.810	145.990 PL 67

Typical Channel Programming for SO-50

Channel (When)	RX Frequency	TX Frequency
1 AOS (Start)	436.785	145.850 PL 67
2 AOS+2 min	436.790	145.850 PL 67
3 MID Pass	436.795	145.850 PL 67
4 LOS -2 min	436.800	145.850 PL 67
5 LOS (End)	436.805	145.850 PL 67

FM Birds Programming

Typical Channel Programming for LilacSat-2

Channel (When)	RX Frequency	TX Frequency
1 AOS (Start)	437.190	144.350
2 AOS+2 min	437.195	144.350
3 MID Pass	437.200	144.350
4 LOS -2 min	437.205	144.350
5 LOS (End)	437.210	144.350

Typical Channel Programming for AO-91

Channel (When)	RX Frequency	TX Frequency
1 AOS (Start)	145.960	435.240
2 AOS+2 min	145.960	435.245
3 MID Pass	145.960	435.250
4 LOS -2 min	145.960	435.255
5 LOS (End)	145.960	435.260

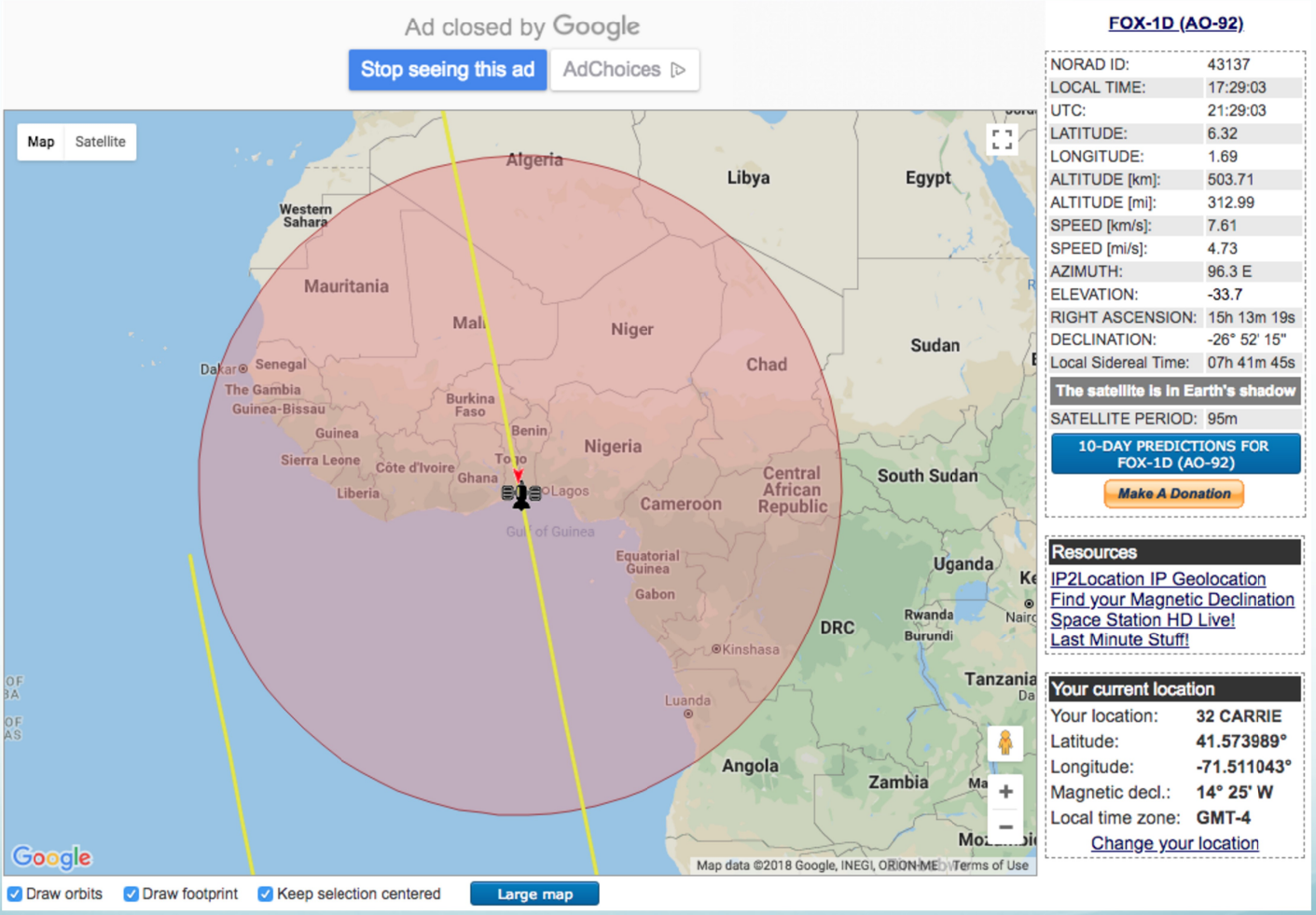
www.amsat.org/track/index.php

AMSAT Online Satellite Pass Predictions - AO-92

View the current location of AO-92

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
07 May 18	00:44:03	00:09:31	121	13	58	9	00:53:34
07 May 18	02:16:26	00:11:23	181	41	281	341	02:27:49
07 May 18	13:45:27	00:09:58	32	15	95	153	13:55:25
07 May 18	15:18:42	00:11:05	2	32	305	214	15:29:47
08 May 18	00:24:46	00:08:01	106	7	63	17	00:32:47
08 May 18	01:56:03	00:11:33	168	82	267	347	02:07:36
08 May 18	03:32:41	00:06:49	237	4	264	310	03:39:30
08 May 18	13:25:45	00:08:27	41	8	84	137	13:34:12
08 May 18	14:58:19	00:11:26	8	62	270	201	15:09:45
08 May 18	16:33:43	00:06:29	336	4	308	266	16:40:12

www.N2YO.com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Map
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Algeria
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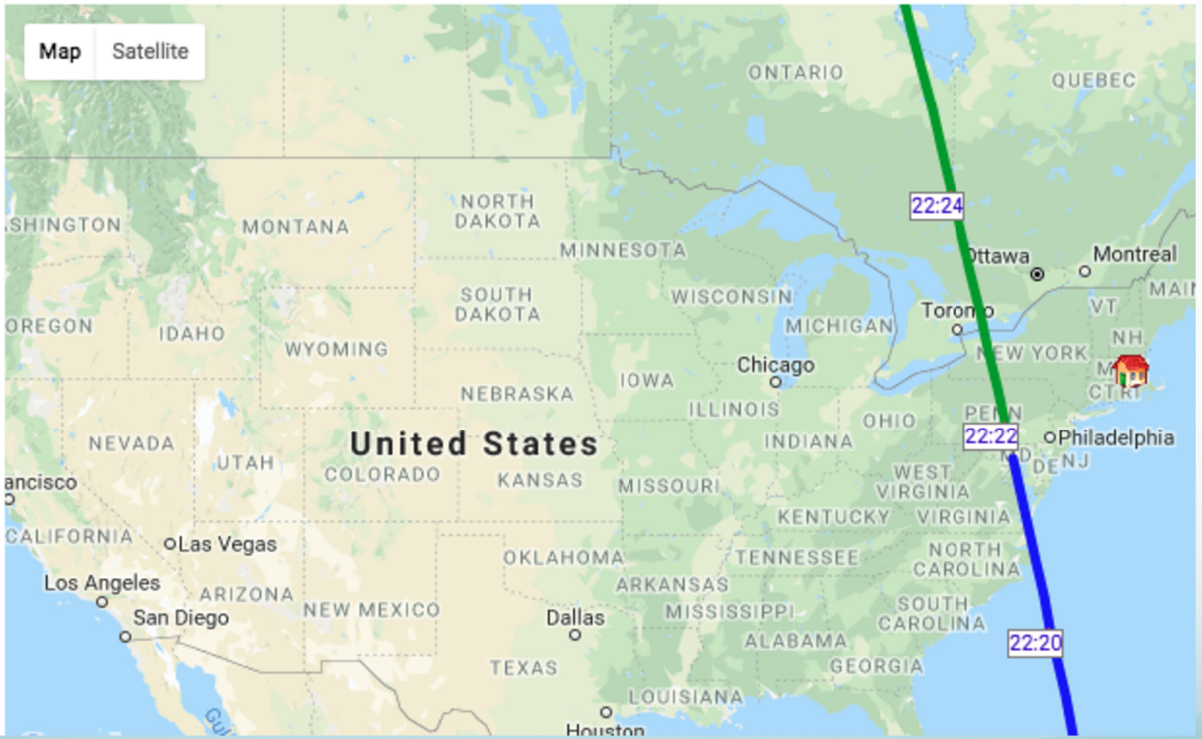
Western Sahara
Mauritania
Mali
Niger
Chad
Sudan
Dakar
Senegal
The Gambia
Guinea-Bissau
Guinea
Sierra Leone
Liberia
Côte d'Ivoire
Burkina Faso
Ghana
Benin
Togo
Nigeria
Lagos
Cameroon
Central African Republic
South Sudan
Gulf of Guinea
Equatorial Guinea
Gabon
Uganda
Rwanda
Burundi
DRC
Kinshasa
Tanzania
Luanda
Angola
Zambia
Google
Map data ©2018 Google, INEGI, ORION-ME
Terms of Use
Draw orbits
Draw footprint
Keep selection centered
Large map
FOX-1D (AO-92)
NORAD ID: 43137
LOCAL TIME: 17:29:03
UTC: 21:29:03
LATITUDE: 6.32
LONGITUDE: 1.69
ALTITUDE [km]: 503.71
ALTITUDE [mi]: 312.99
SPEED [km/s]: 7.61
SPEED [mi/s]: 4.73
AZIMUTH: 96.3 E
ELEVATION: -33.7
RIGHT ASCENSION: 15h 13m 19s
DECLINATION: -26° 52' 15"
Local Sidereal Time: 07h 41m 45s
The satellite is in Earth's shadow
SATELLITE PERIOD: 95m
10-DAY PREDICTIONS FOR FOX-1D (AO-92)
Make A Donation
Resources
IP2Location IP Geolocation
Find your Magnetic Declination
Space Station HD Live!
Last Minute Stuff!
Your current location
Your location: 32 CARRIE
Latitude: 41.573989°
Longitude: -71.511043°
Magnetic decl.: 14° 25' W
Local time zone: GMT-4
Change your location

www.N2YO.com

Pass beginning	Max altitude	Pass ending
Date: 6-May 22:16:40	Date: 6-May 22:22:0	Date: 6-May 22:27:20
Az: 181.73° (S)	Az: 257.61° (W)	Az: 340.19° (NNW)
El (alt): 0.95°	El (alt): 42.77°	El (alt): 1.76°
Mag: -	Mag: -	Mag: -
Dist to sat: 2486.9 km	Dist to sat: 720.4 km	Dist to sat: 2414.7 km
Eclipsed?: YES	Eclipsed? NO	Eclipsed? NO

Barely visible pass | Add this pass on your notifications list



www.N2YO.com

10-DAY PREDICTIONS

Object name	**FOX-1D (AO-92)** Live tracking | More info
Catalog #	43137, 2018-004A
Observing location	32 CARRIE LN, N
Observing coord.	Lat: 41.57°, Lng: -71.51° Change
Local time zone	GMT -4

Uplink (MHz): 435.350/1267.350
Downlink (MHz): 145.880
Beacon (MHz): 145.880
Mode: FM CTCSS 67.0Hz/200bps DUV
Call sign:
Status: Active

Visible passes | AM/PM time | UTC | Print as PDF

Start		Max altitude			End		All passes	
Date, Local time	Az	Local time	Az	El	Local time	Az	Mag	Info
6-May 20:44	ESE 119°	**20:48**	**ENE 67°**	**13°**	20:53	N 12°	-	Map and details
6-May 22:16	S 182°	**22:22**	**W 258°**	**43°**	22:27	NNW 340°	-	Map and details
7-May 09:45	NE 33°	**09:50**	**E 90°**	**15°**	09:55	SSE 151°	-	Map and details
7-May 11:19	N 2°	**11:24**	**WNW 285°**	**34°**	11:29	SW 215°	-	Map and details
7-May 21:56	S 169°	**22:01**	**SW 224°**	**80°**	22:07	N 347°	-	Map and details
8-May 10:58	N 8°	**11:04**	**WNW 290°**	**62°**	11:09	SSW 201°	-	Map and details
8-May 21:36	SSE 156°	**21:41**	**ENE 65°**	**53°**	21:46	N 354°	-	Map and details
9-May 10:38	N 14°	**10:43**	**E 85°**	**69°**	10:49	S 188°	-	Map and details
9-May 21:16	SE 143°	**21:21**	**ENE 71°**	**30°**	21:26	N 1°	-	Map and details
9-May 22:50	SSW 203°	**22:55**	**W 265°**	**17°**	22:59	NW 327°	-	Map and details

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Thank You

Questions???

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