

Satellites for Beginners

Newport County Radio Club
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✗ Don't think this...



✓ Think this...



Satellites are “Repeaters in the sky”

Today there are SIX Easy FM Voice Satellites

- SO-50 (SaudiSat, Dec 2002)
- ISS Crossband (Sep 2020)
- PO-101 (Oct 2018)
- AO-91 (Fox1B, Nov 2017)
- AO-92 (Fox1D, Jan 2018)
- AO-27 (Sep 1993 – back from the dead!!)

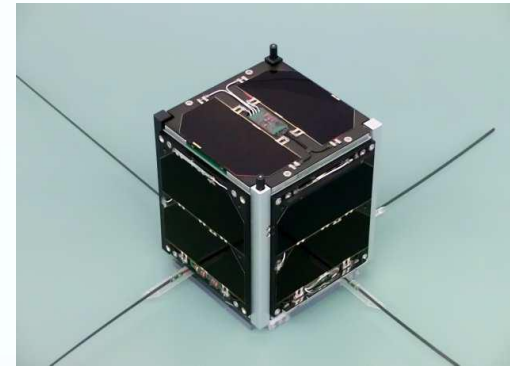
Notice
Something?
Lots of fairly
new satellites!!!

There are 12 CW/SSB Satellites & 6 Digital Ones

More coming all the time!

Why so many new satellites?

CubeSats !!!



- Standard Form Factor 10x10x10cm 1.3 Kilogram
- Off-the-shelf frames and PCBs available
- Low construction cost (\$20K)
- Low launch cost (\$50K – often free)

CubeSat Launch

Think Expensive Pez Dispenser



Repeaters in the sky

- Just like a Repeater we transmit on one frequency and listen on another
- Unlike most repeaters satellites are cross band
 - 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 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)

Can use a single HT and not listen with FM sats

✓ “Sky” is good...

- Line of sight to everywhere
- Big coverage footprint (Continental United States)



✗ “Sky” is not so good...

- Orbiting about 400 miles up so greater signal loss compared to a typical repeater 25 miles away
- Low Satellite TX power (maybe 0.3 to 3 watts)
- Moving FAST (16,000 MPH)
 - **Short time to access (about 10 minutes)**
 - **Doppler**
- Busy (especially weekends and Field Day)

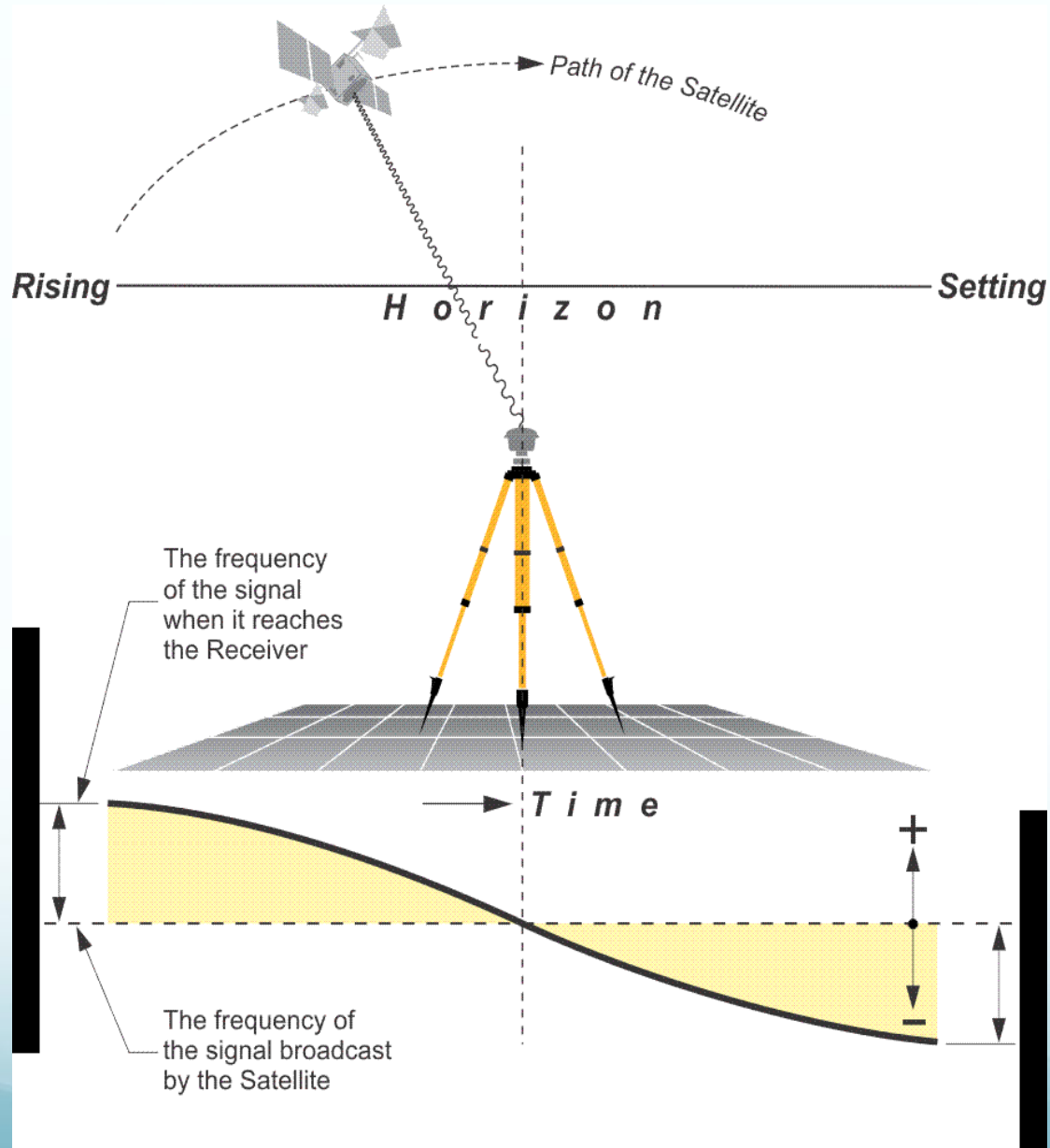
What is Doppler?

- 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”)

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

How do we know where Satellites are?

- Use Online Prediction Services
 - <http://www.N2YO.com>
 - <http://www.amsat.org/track/index.php>
- Use Smartphone Tools (SatSat on iPhone, AmsatDroid FREE for Android phones)
- Use Installed PC tools
 - GPREDICT (Windows, Linux)
 - MacDoppler (Mac)

www.N2YO.com

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Map Satellite

Google

Map data ©2018 Google, INEGI, ORION-MED, 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](#)

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

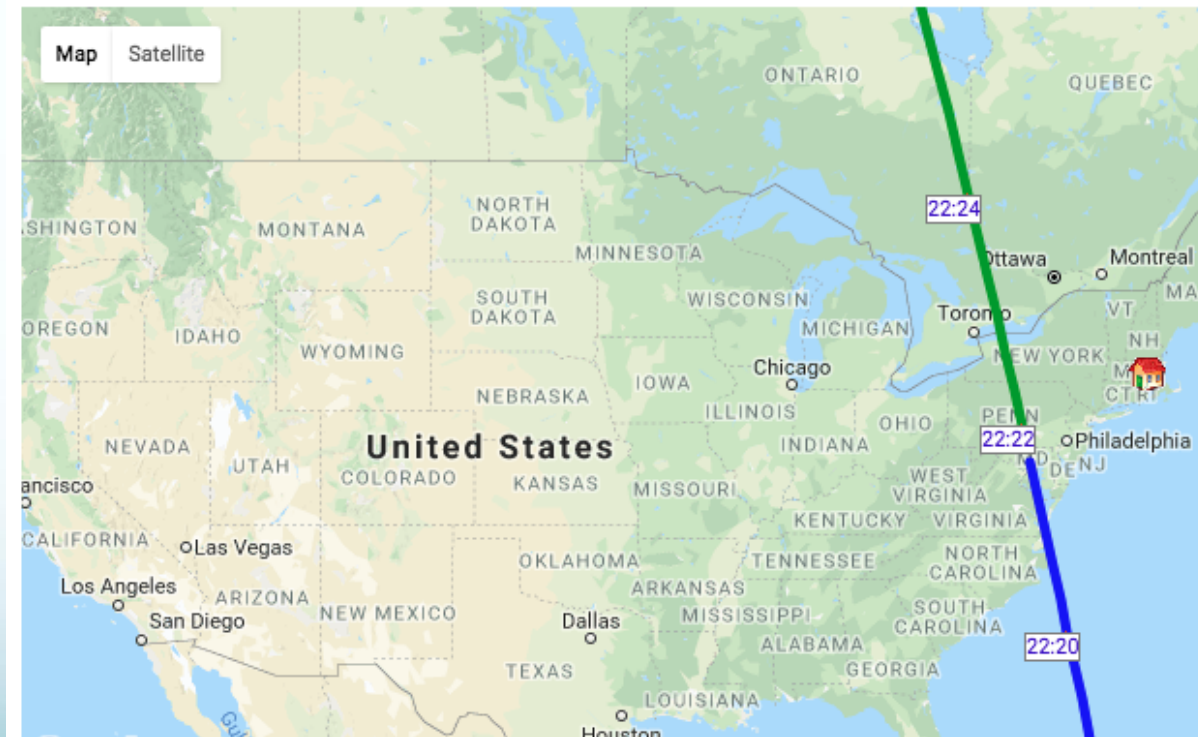
Visible passes		AM/PM time		UTC		Print as PDF		
Start 		Max altitude			End 		All passes	
Date, Local time	Az	Local time	Az	EI	Local time	Az	Mag ⓘ	Info
6-May 20:44	ESE 119°	20:48	ENE 67°	13°	20:53	N 12°	-	Map and details
6-May 22:16	S 182°	22:22	W 258°	43°	22:27	NNW 340°	-	Map and details
7-May 09:45	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

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.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

Basic Contact Plan

- 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”
- “W1SEA this is Whiskey Bravo Four Sierra Oscar November WB4SON in Fox Nancy Forty One over”

Contact Plan Pt 2

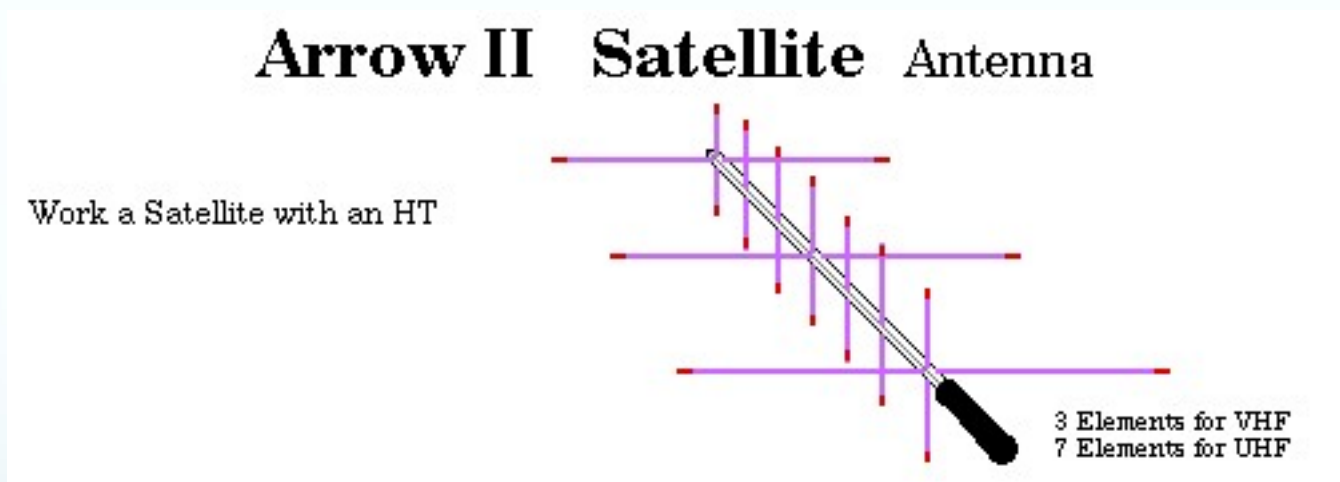
- Adjust the UHF frequency (usually uplink) during the pass (AOS, +2 min, +4 min, +8 min, +10 min)
- Move your antenna for max signal as satellite moves across the sky
- Log your contacts and upload to LOTW!

Keep contacts short!! (Allow others time)

Gear

Antenna Crossed 2m/70cm Beam:

www.arrowantennas.com/arrowii/146-437.html



Other choices: Elk Antenna, Homebrew

Gear

- 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)
- Or, in a pinch, just one HT that can operate split band (but you give up receive while transmit)

Lots of USED HTs with full duplex



Lazy Man's Approach

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

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

Wait for the satellite to find you (about two minutes before mid-pass thru two minutes after). Make contacts during that window.





Misc Info.

- Frequency List
 - <https://www.amsat.org/fm-satellite-frequency-summary/>
- 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>
- AMSAT UK (good website)
 - <https://amsat-uk.org/>