

Working the Birds

An Introduction to FM Satellites

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KD5RYO

Who am I?

- **Trailerparkansas native**
- **Mercenary Janitor by day...**
- **General class ~~h~~ ham by night**
- **First licensed in 2003, re-licensed in 2017**
- **FM Satellites, QRP, CW, SWL, & SDR**
- **Affiliations: SDF ARC & NAQCC**
- **Find me on QRZ or at manor.space**

What will you be subjected to tonight?

- **An overview of applied theory of FM Satellites**
 - Other types of birds exist, they won't be covered here.
 - No history lesson
 - Very little actual science
- **The “how”, not the “why”**
- **The quickest way path to your first QSO**
- **My social anxiety and opinionated ranting**
- **Potential misinformation via my ignorance**

Why should you listen to me?

- **Because I've made contact!**
 - First QSO was through ARISS
 - Various contacts thereafter
- **Because I've made a lot of mistakes!**
 - Using doppler to sound like Donald Duck
 - THE EYE GOUGER
 - Spurious Emissions (just lid things...)
- **Because you can have fun!**

Who can I talk to?

- **That all depends on the orbit**
 - The higher the satellite's orbit, the greater its footprint and length of the pass
 - The inverse is also true
- **This is a lot like fishing**
 - Sometimes you get out and sometimes you don't

Real talk: how much will this cost me?

- **Probably nothing...**
 - Do you have an HT?
 - Do you have a whip (or better yet a dual band beam?)
 - Do you have a computer or smart phone?
 - Can you borrow or steal one or are you REALLY good with math?
 - Can you use a compass or do you know where North is?
- **Or potentially your life savings**
 - Look into high end rigs and computer controlled stations

Radios

- **Simple HT (3-5W) or portable station (10-50W)**
- **Computer controlled base stations**
- **Duplexing not necessary but helpful**

Antennas

- **Dual band beam**
- **HT whip (no duckies)**
- **Computer controlled beam and rotor**
- **DIY or Commercial**
 - Tape measure, coat hanger, Elk, Arrow, etc.
 - Two bands on the same stick
 - Duplexer/Splitters

Computers and Software

- **Laptop/Desktop**

- gPredict (Linux), heavens-above.com, nova (Windows), n2yo.com, SatPC32 (Windows), lots of others...

- **Smartphone**

- Amsatdroid, Satellite Explorer (iOS)

Accessories

- **Compass**
- **Voice recorder**
- **Pencil and paper**
- ~~**Slave labor**~~ **friends, family, or a sturdy tripod**
- **Headphones**
- **Headlamp**
- **Watch or clock**
- **Stubbornness**

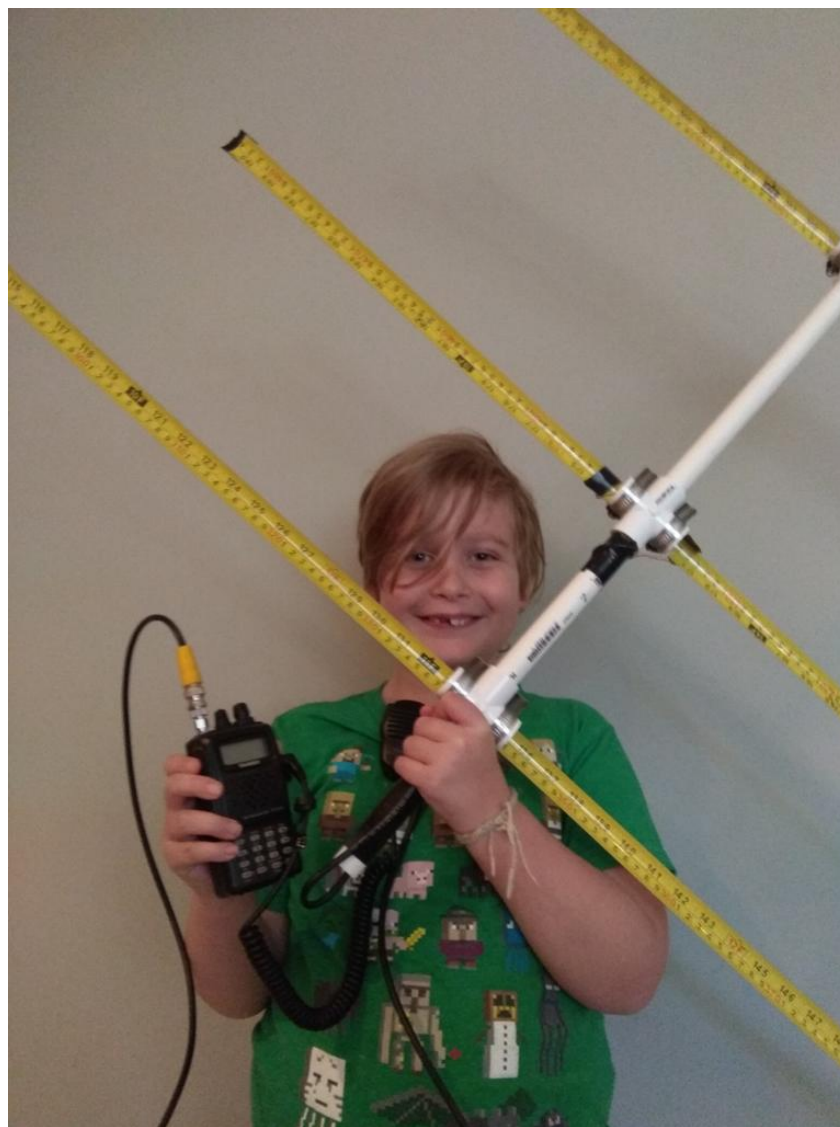
My gear

- **Yaesu FT-60R**
 - Hand mic or CT-44 cable and headphones
- **Tape measure Yagi**
- **Netbook with gPredict**
- **Headlamp**
- **Voice recorder**
- **Compass**
- **Wristwatch**
- **Insomnia**

How to work an FM Satellite

- **Program your radio for doppler shift and transponder activation**
- **Know the upcoming passes**
- **Map out the pass from your working location**
- **Start at the appropriate freq with OPEN SQUELCH and transmit only when you clearly hear the bird.**
- **Be sure to keep tuning your radio to compensate for doppler shift**
- **PLEASE record the path status with AMSAT**
- **If all else fails, bring out your secret weapon!**

TOP SECRET WEAPON



Programming your radio

- **Determine if you need to adjust for doppler on uplink or downlink**
- **Set several frequencies in 5KHz steps**
- **Appropriately name these steps if you can (SO-50+N, SO-50MID, SO-50-ACT, SO-50-N)**

Know the upcoming passes

- **Choose your software or site**
- **Pick up “keps” if necessary**
 - These describe orbits
- **Find a useful pass**
- **Write down or store the pass data somehow.**

Know the upcoming passes

GPREDICT: Amateur

File Edit Help

2017/07/05 20:58:50

KD5RYO · Siloam Springs, Arkansas

Next: SO-50 in 01:24:31

LILACSAT 2

ISS

AO-85

KD5RYO

SO-50

Next: SO-50 in 01:24:31

W N E S

AO-85

Azimuth : 256.11°
 Elevation : -21.72°
 Slant Range : 6008 km
 Range Rate : -5.469 km/sec
 Next Event : AOS: 2017/07/
 SSP Loc. : BK61LG
 Footprint : 5248 km
 Altitude : 581 km
 Velocity : 7.606 km/sec
 Doppler@100M : 1824 Hz
 Sig. Loss : 147.98 dB
 Sig. Delay : 20.04 msec
 Mean Anom. : 215.46°

Satellite	Az	El	Dir	Range	Next Event	Alt	Orbit
AO-85	256.11°	-21.72°	↑	6008	AOS: 2017/07/06 02:17:10	581	257
ISS	21.59°	-43.47°	↓	9362	AOS: 2017/07/06 02:56:41	409	2467
LILACSAT 2	342.40°	-17.96°	↓	5278	AOS: 2017/07/06 06:42:43	534	9901
SO-50	135.15°	-8.79°	↓	4059	AOS: 2017/07/05 22:23:22	642	78189

LON:179° LAT:-46°

SO-50 AOS in 01:24:31

79F, Partly Cloudy | 64.2 GiB | W: (033% at openwireless.org) 192.168.1.151 | E: down | CHR 69.77% | 0.75 | 2017-07-05 20:58:50

Know the upcoming passes

AOS	LOS	Duration	Max El	AOS Az	Max El Az	LOS Az	Vis
2018/07/05 22:32:06	2018/07/05 22:44:14	00:12:08	14.64°	346.51°	44.72°	102.69°	-D-
2018/07/06 00:11:58	2018/07/06 00:26:21	00:14:22	76.00°	327.74°	244.14°	155.70°	-D-
2018/07/06 01:54:14	2018/07/06 02:03:19	00:09:04	6.34°	295.86°	256.09°	216.02°	-D-
2018/07/06 14:23:28	2018/07/06 14:37:04	00:13:35	65.07°	201.34°	105.19°	33.53°	-D-
2018/07/06 16:05:17	2018/07/06 16:17:01	00:11:43	14.76°	256.22°	316.51°	13.85°	-D-
2018/07/06 22:56:54	2018/07/06 23:10:39	00:13:45	30.60°	339.20°	52.14°	125.10°	-D-
2018/07/07 00:37:24	2018/07/07 00:50:55	00:13:30	29.44°	317.90°	248.27°	177.58°	-D-
2018/07/07 13:09:39	2018/07/07 13:21:09	00:11:29	15.67°	166.99°	106.98°	50.16°	-D-
2018/07/07 14:48:41	2018/07/07 15:02:14	00:13:32	46.79°	223.40°	310.24°	24.89°	-D-
2018/07/07 16:32:26	2018/07/07 16:41:36	00:09:10	6.41°	281.61°	324.36°	5.84°	-D-

Print Save Close

Know the upcoming passes

Pass details for SO-50 (orbit 81967)
 Observer: KD5RY0, Siloam Springs, Arkansas
 LAT:36.20 LON:-94.48
 AOS: 2018/03/19 00:19:22 Local
 LOS: 2018/03/19 00:33:37 Local

Time	Az	El	Range	Footp	Dop	Loss
2018/03/19 00:19:22	330.18	0.00	3004	5620	2195	141.95
2018/03/19 00:20:05	330.49	2.69	2723	5624	2193	141.10
2018/03/19 00:20:47	330.83	5.70	2443	5627	2184	140.16
2018/03/19 00:21:30	331.22	9.15	2164	5631	2166	139.10
2018/03/19 00:22:13	331.70	13.25	1888	5634	2134	137.92
2018/03/19 00:22:56	332.30	18.31	1618	5637	2081	136.58
2018/03/19 00:23:38	333.13	24.84	1356	5640	1987	135.05
2018/03/19 00:24:21	334.43	33.78	1111	5642	1817	133.32
2018/03/19 00:25:04	336.91	46.66	897	5645	1493	131.46
2018/03/19 00:25:47	344.07	65.30	741	5647	887	129.80
2018/03/19 00:26:29	68.47	83.62	684	5648	-39	129.10
2018/03/19 00:27:12	137.13	63.81	750	5650	-947	129.90
2018/03/19 00:27:55	143.60	45.65	912	5652	-1526	131.60
2018/03/19 00:28:38	145.93	33.16	1130	5653	-1834	133.46
2018/03/19 00:29:20	147.15	24.45	1376	5654	-1996	135.17
2018/03/19 00:30:03	147.93	18.06	1638	5655	-2085	136.69
2018/03/19 00:30:46	148.48	13.09	1909	5656	-2137	138.02
2018/03/19 00:31:29	148.89	9.05	2185	5656	-2167	139.19
2018/03/19 00:32:11	149.23	5.64	2464	5657	-2183	140.23
2018/03/19 00:32:54	149.50	2.66	2744	5658	-2192	141.17
2018/03/19 00:33:37	149.73	-0.00	3025	5658	-2194	142.02

Pass details for SO-50 (orbit 83559)

Data Polar Az/El

Time	Az	El	Range	Footp	Dop	Loss
2018/07/06 00:11:58	327.74°	0.00°	3049	5692	2186	142.08
2018/07/06 00:12:41	327.51°	2.69°	2767	5695	2183	141.24
2018/07/06 00:13:24	327.20°	5.69°	2485	5697	2173	140.31
2018/07/06 00:14:08	326.75°	9.14°	2205	5699	2155	139.27
2018/07/06 00:14:51	326.12°	13.20°	1928	5700	2123	138.10
2018/07/06 00:15:34	325.20°	18.18°	1656	5701	2068	136.78
2018/07/06 00:16:17	323.77°	24.56°	1394	5701	1973	135.29
2018/07/06 00:17:00	321.34°	33.16°	1149	5701	1804	133.61
2018/07/06 00:17:43	316.54°	45.28°	934	5701	1488	131.81
2018/07/06 00:18:26	303.58°	62.00°	776	5700	907	130.19
2018/07/06 00:19:10	244.14°	76.00°	713	5700	23	129.46
2018/07/06 00:19:53	181.27°	62.77°	770	5698	-872	130.13
2018/07/06 00:20:36	167.57°	45.85°	925	5697	-1468	131.72
2018/07/06 00:21:19	162.58°	33.53°	1138	5695	-1793	133.52
2018/07/06 00:22:02	160.06°	24.79°	1383	5693	-1968	135.21
2018/07/06 00:22:45	158.57°	18.32°	1644	5691	-2065	136.72
2018/07/06 00:23:29	157.59°	13.29°	1915	5688	-2121	138.04
2018/07/06 00:24:12	156.90°	9.19°	2192	5686	-2155	139.22
2018/07/06 00:24:55	156.39°	5.72°	2472	5683	-2174	140.26
2018/07/06 00:25:38	156.00°	2.70°	2754	5680	-2183	141.20
2018/07/06 00:26:21	155.70°	-0.00°	3037	5677	-2187	142.05

Print Save Close

Preparing for the pass

- **Start with the azimuth AOS, MID, & EOS**
- **Note your working window based on elevation**
- **Take your compass away from any large metal structures**
- **Shoot the three azimuths to determine what the pass looks like from the ground**
- **Use your polar data to help with your mental image**

Get out and find the satellite

- **Make sure your watch is set properly and head to your working location**
- **Start with your radio set above the center frequency**
- **Point your antenna toward the azimuth for AOS**
- **Work your antenna over the satellite's path, tuning for doppler and listening for quieting**
- **LISTEN, LISTEN, LISTEN**
- **Make contact (hopefully)**

Typical QSO

- **If the transponder is not active**
 - Move on and work another bird another day
- **If you wish to call**
 - Give your call, location (gridsquare), and maybe mode of operation phonetically.
 - Exchange signal report, say thanks, and move on quickly
- **If you wish to tail a pileup**
 - Give their call followed by your own
 - Exchange signal report, say thanks, and move on quickly

Active FM satellites

- **SO-50**
- **AO-85 (“FOX-1A”)**
- **AO-92 (“FOX-1D”)**
- **AO-91 (“FOX-1B”)**
- **ISS**

Some tips

- **Always keep tuning for doppler**
- **Pay attention to the mailing lists**
- **Checkout amsat.org/status (and update it!)**
- **Keep your hands as free as possible**
- **Record your QSOs for easy recall**
- **Work nights if possible**
- **Skeds and activating transponders are mostly futile without a “real” station**

Where to learn more

- **amsat.org**
- **work-sat.com**
- **AMSAT mailing list**
- **StarcomBB mailing list**

THANK YOU!