

Amateur Radio Satellites 101

An introduction to the AMSAT “Easy Sats”



Presented to the:
Fayette County Amateur Radio Club



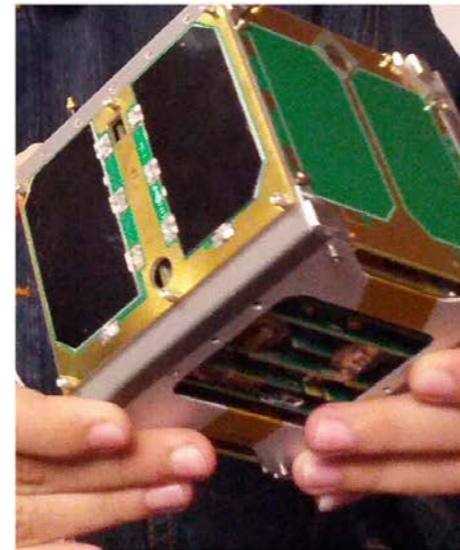
Presented by:
Joe Domaleski, KI4ASK
AMSAT #41409
KI4ASK@ARRL.NET

Date: November 21, 2019
Revision 2

The real title of this presentation



How to have a QSO on a repeater that is 4 inches square, traveling 17,000 MPH 600 miles away, in outer space, with a handheld radio, running 5 watts.



Agenda



- Why satellites?
- Where are the satellites located?
- What is a “hamsat”?
- What are the Easy Sats?
- What’s inside a hamsat?
- An example pass of AO-91
- Emergency traffic via AO-92
- Basic equipment I use
- An example pass of AO-92
- Here’s how to make your 1st QSO
- Where the “cool kids” hang out
- Some memorable QSO’s
- Other satellite topics
- Some general tips
- Suggested resources



Stone Mountain Hamfest 2019
with Daryl Young, K4RGK
President of NFARL &
AMSAT Ambassador

Why satellites?

- Easy to get started
- Only need a Technician license
- Doesn't require expensive gear
- DX when HF conditions are poor
- Science involved in tracking
- Camaraderie of AMSAT community
- Skill involved in making contact
- Fun for kids of all ages
- Adds another skill to your toolkit
- Like “foxhunting” in the sky
- The passes are short
- The wonderment of it all
- Because I couldn't be an astronaut
- It's a lot of fun!



Example QSO with K5DCC

<https://www.facebook.com/dennyj/videos/10157742522839570/>

Where are the satellites located?

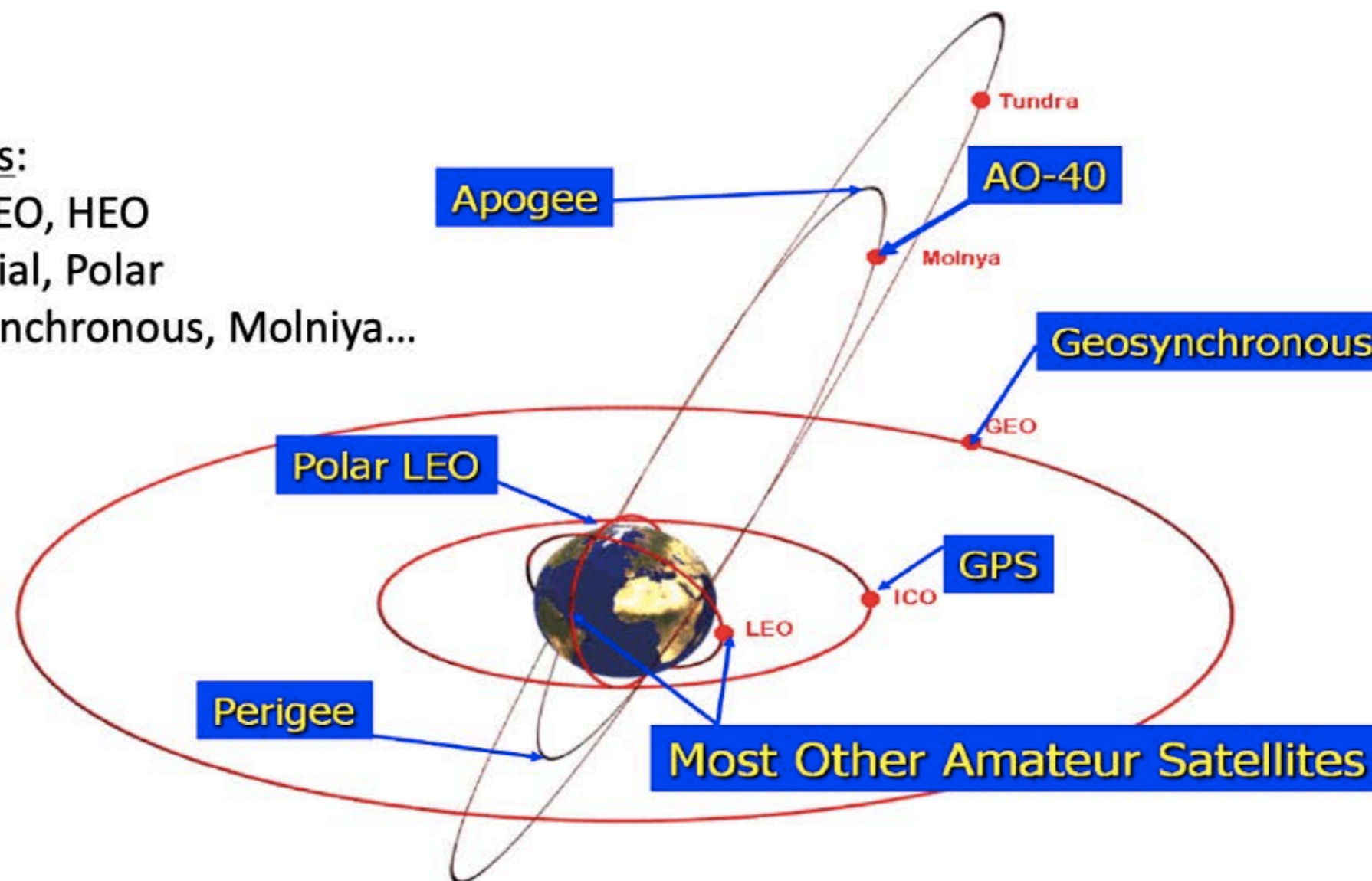


Different Orbits:

Height: LEO, GEO, HEO

Plane: Equatorial, Polar

Special: Sun Synchronous, Molniya...



The Easy Sats are in LEO – 300-600 miles up

What is a “Hamsat”?

- Repeater in space
- Small in size, large in footprint
- Usually travels around 17,000 MPH
- Uses VHF / UHF for communications
- OSCAR – Orbiting Satellite Carrying Amateur Radio
- FM Satellites – single channel “party line” a.k.a “Easy Sats”
- Linear (CW/SSB): 20-100 kHz “band” many stations share bandwidth
- Digital – APRS, Packet, SSTV



Picture of Anita Kemmerer (AB1QB)
holding a CubeSat
picture by Fred Kemmerer (AB1OC):

We’re going to focus on the most popular – the “Easy Sats”
AO-85, SO-50, AO-91, AO-92

What are the Easy Sats?



The FM birds that are easy to work!

SO-50 (2-meter uplink/ 70-centimeter downlink)

Part of Pass	TX Freq. (67Hz CTCSS)	RX Freq.
AOS	145.850 MHz	436.805 MHz
	145.850 MHz	436.800 MHz
Middle	145.850 MHz	436.795 MHz
	145.850 MHz	436.790 MHz
LOS	145.850 MHz	436.785 MHz

AO-85 Fox-1A (70-centimeter uplink, 2-meter downlink)

Part of Pass	TX Freq. (67Hz CTCSS)	RX Freq.
AOS	435.160 MHz	145.980 MHz
	435.165 MHz	145.980 MHz
Middle	435.170 MHz	145.980 MHz
	435.175 MHz	145.975 MHz
LOS	435.180 MHz	145.975 MHz



AO-91 RadFXSat/Fox-1B (70-centimeter uplink, 2-meter downlink)

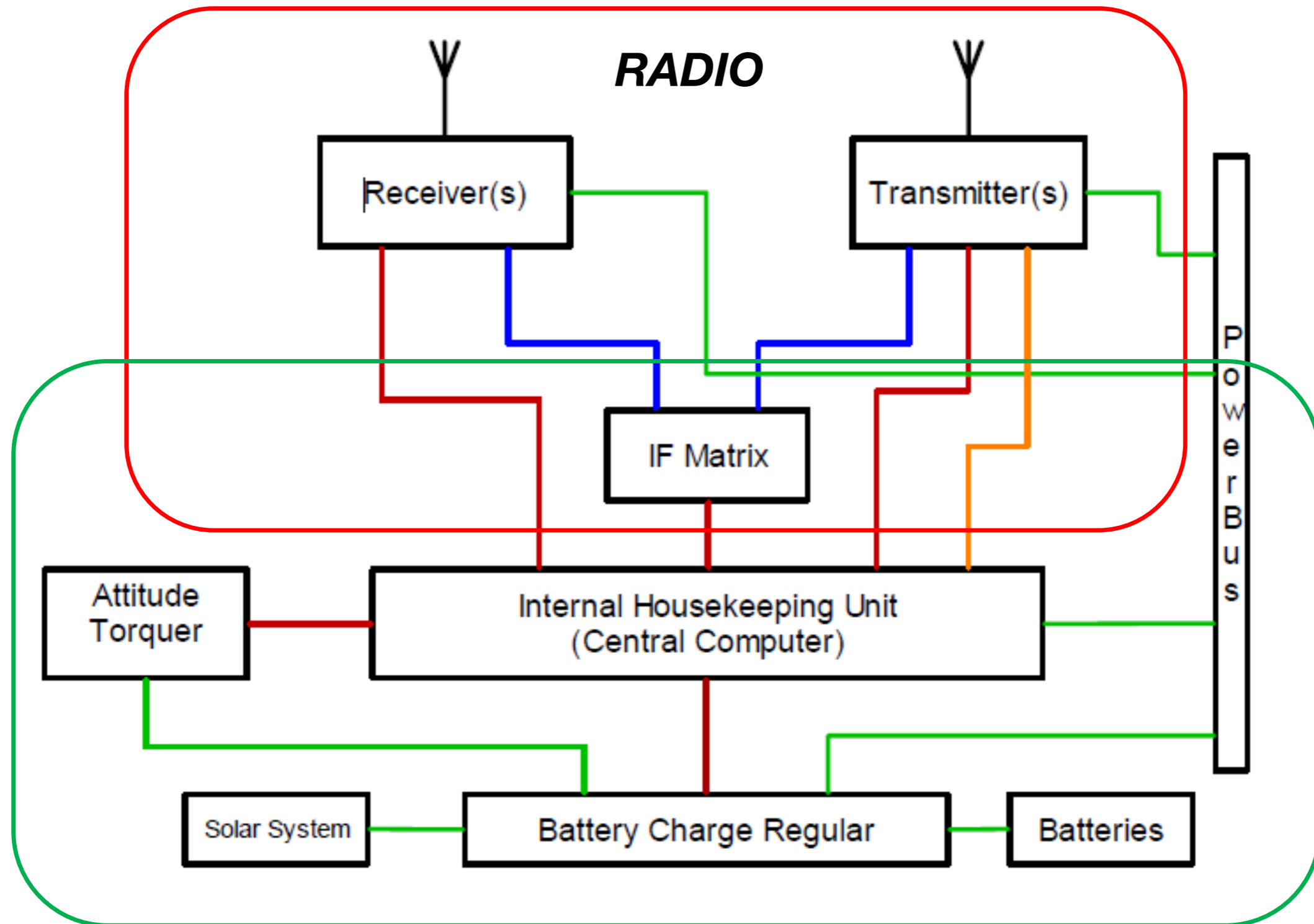
Part of Pass	TX Freq. (67Hz CTCSS)	RX Freq.
AOS	435.240 MHz	145.960 MHz
	435.245 MHz	145.960 MHz
Middle	435.250 MHz	145.960 MHz
	435.255 MHz	145.960 MHz
LOS	435.260 MHz	145.960 MHz

AO-92 Fox-1D (70-centimeter uplink, 2-meter downlink)

Part of Pass	TX Freq. (67Hz CTCSS)	RX Freq.
AOS	435.340 MHz	145.880 MHz
	435.345 MHz	145.880 MHz
Middle	435.350 MHz	145.880 MHz
	435.355 MHz	145.880 MHz
LOS	435.360 MHz	145.880 MHz

Source: *Getting on the Satellites for ARRL Field Day*
by Sean Kutzko, KX9X (QST Magazine, June 2018)

What's inside a Hamsat?



Source: Steve Green (KS1G) & Paul Stoetzer (N8HM)

An example pass of AO-91



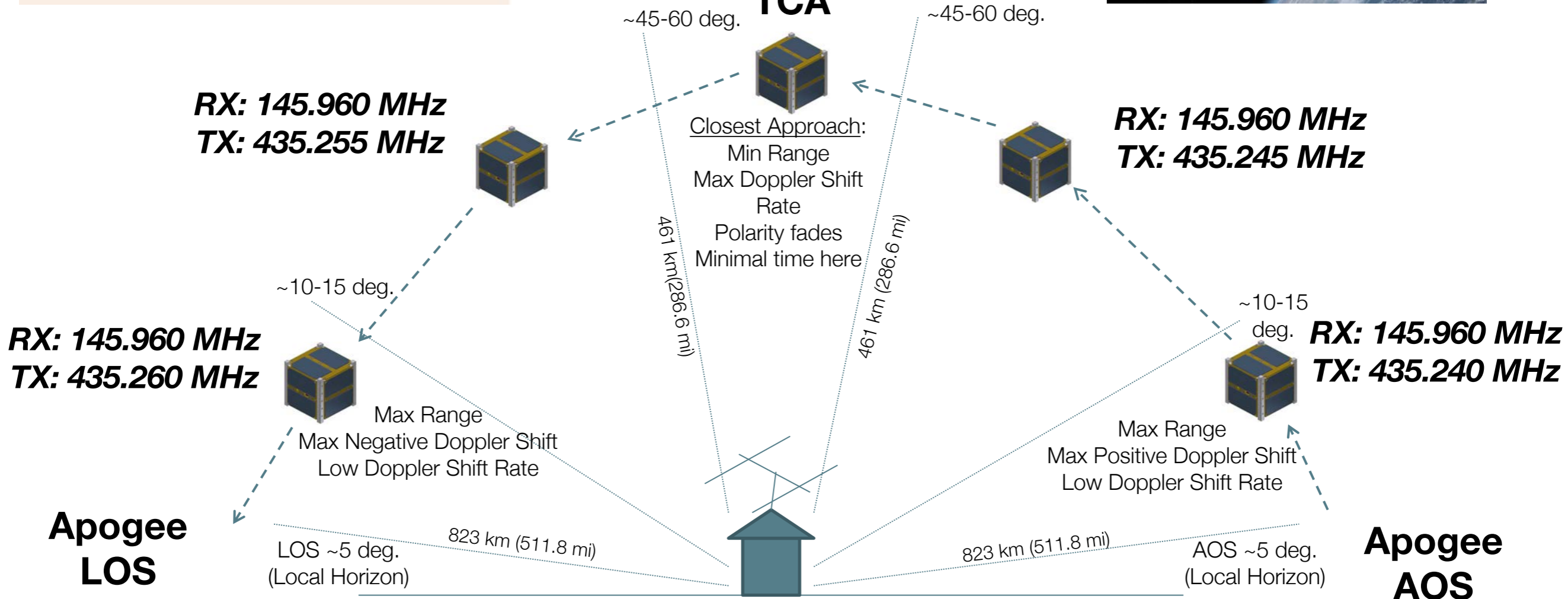
AO-91 RadFXSat/Fox-1B (70-centimeter uplink, 2-meter downlink)

Part of Pass	TX Freq. (67Hz CTCSS)	RX Freq.
AOS	435.240 MHz	145.960 MHz
Middle	435.245 MHz	145.960 MHz
LOS	435.255 MHz	145.960 MHz
	435.260 MHz	145.960 MHz



RX: 145.960 MHz
TX: 435.250 MHz

Perigee TCA



Modified from source material by: Steve Green (KS1G) & Paul Stoetzer (N8HM)

Emergency traffic via AO-92 (8/27/19)



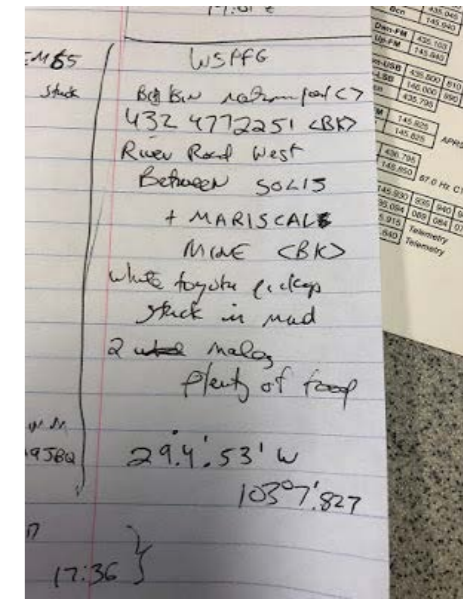
August 27, 2019 (Big Bend National Park, TX), Clayton, W5PFG, and his father Jack, AC5DI, were traversing the Chihuahuan Desert in Big Bend National Park, Texas, USA, when their vehicle became stuck in mud from recent monsoon rains.

Being stuck up to the axles, they were unable to self-recover from the situation, requiring assistance from Park Rangers. August temperatures in this desert reach upwards of 110-115 degrees Fahrenheit. There is no mobile phone coverage outside park headquarters.

Clayton made contact via AMSAT satellite AO-92 with Kevin, KK4YEL, in Florida. During the satellite pass, stations stood by while Clayton relayed emergency traffic to Kevin. This information included details about the situation including precise latitude and longitude, the phone number for Big Bend National Park, vehicle description, and welfare of the party.

Article: AMSAT - <https://www.amsat.org/emergency-traffic-relayed-over-ao-92-satellite/>
Pictures by: Clayton Coleman, W5PFG & Kevin Zari, KK4YEL

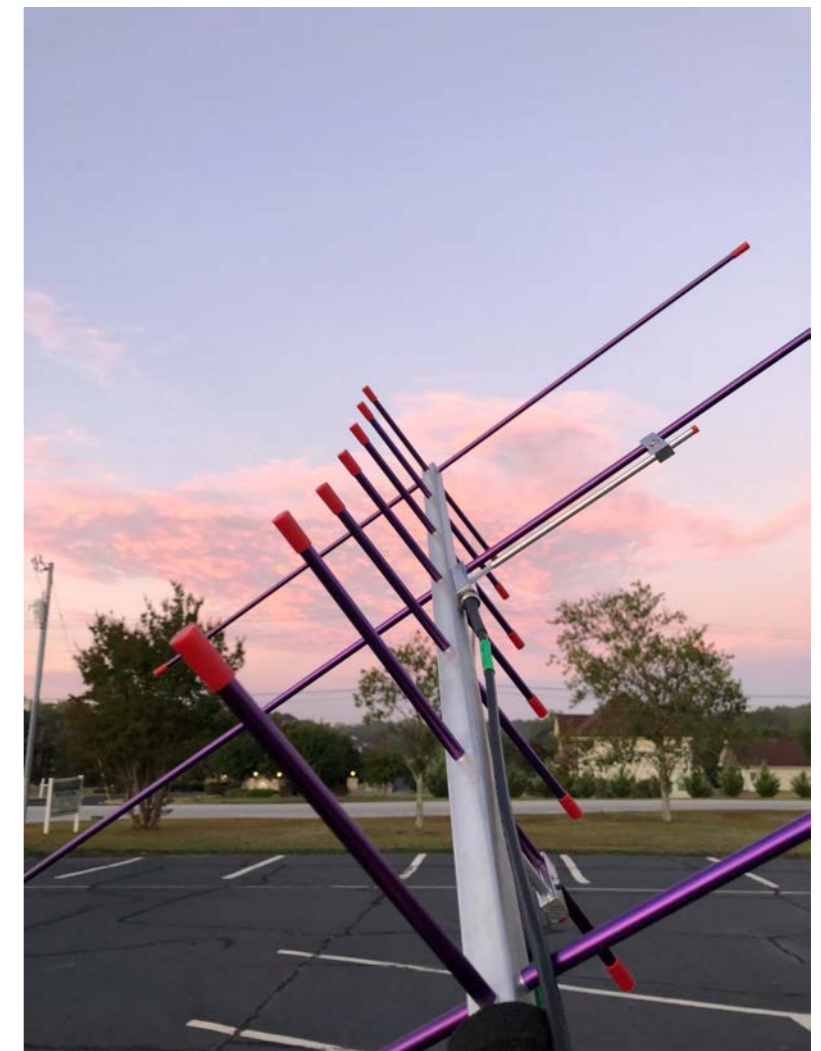
Recording by KQ4MM - <https://twitter.com/KQ4MM/status/1166396579416354816>
Recording by W5CBF - <https://twitter.com/CO6CBF/status/1166432549847085056>



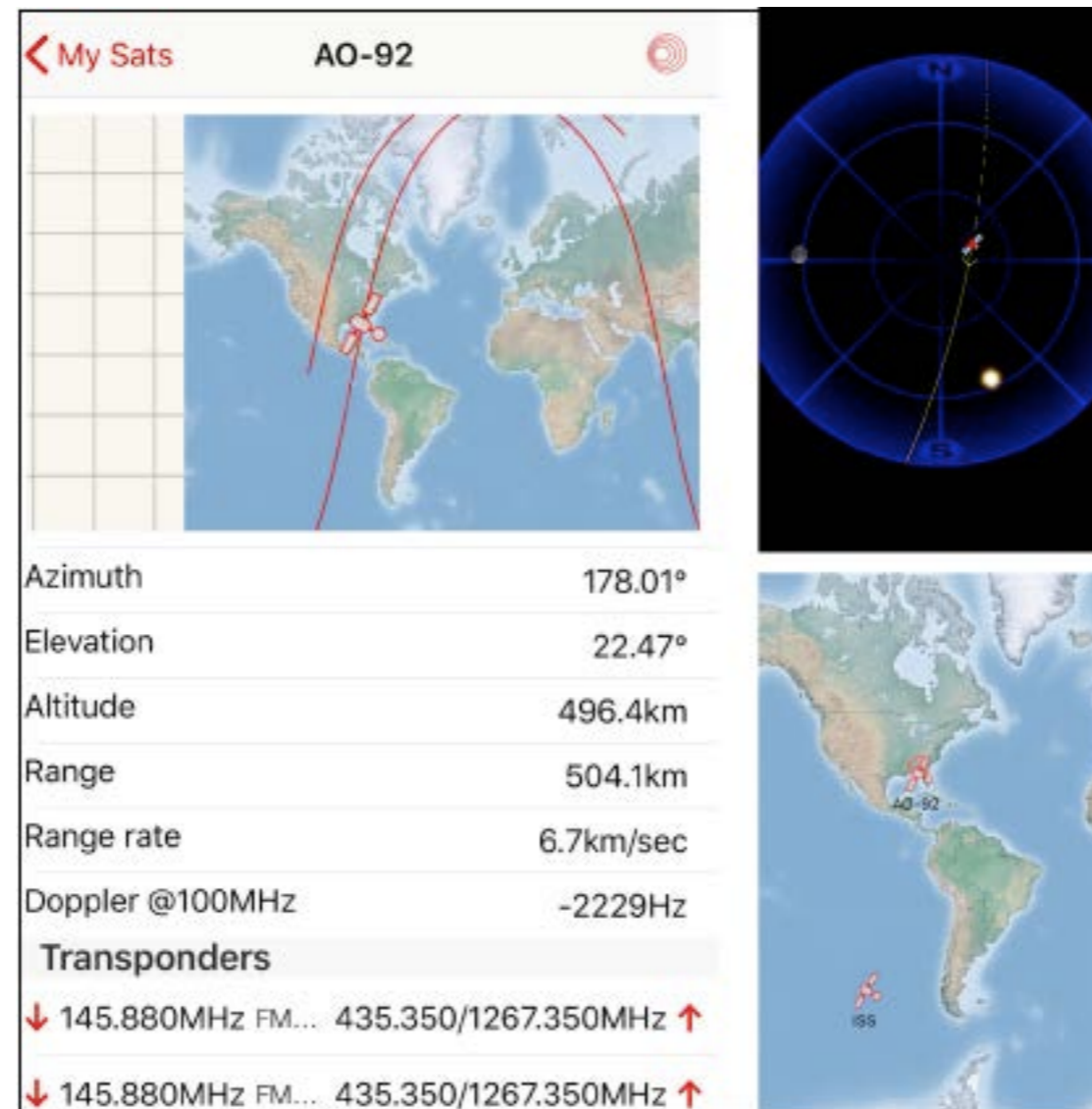
Basic equipment I use



- Arrow dual-band yagi (2m/70cm)
- RX - Kenwood TH-D74
 - Record function!
 - APRS
 - FM & SSB!
- TX – Baofeng UV-5R
- 2 SMA-to-BNC adapters
- Tracking apps
 - Droid – Heavens Above
 - iOS - GoSatWatch



An example pass of AO-92 (11/19/19)



[Click here](#) to play the QSO audio.

Note the QSO with K5DCC – same as in earlier video

Here's how to make your first QSO



1. Status – what's on?

- <https://amsat.org/status>

2. Tracking – where's it at?

- <https://heavens-above.com>
- Use an app

3. Reception – listen first

- If you can't hear it,
don't work it

4. Transmit – make your contact!

- Call & Grid – KI4ASK EM73



Where the “cool kids” hang out



[@AMSAT](#)

[#AMSAT](#)

[#hamradio](#)

[@joedom](#) (that's me!)



The Grid Life

@The_Grid_life Follows you

Following

Pssst! Hey you...ya you! Looking for some grids? I got you covered.



AMSAT @AMSAT · 20h

AO-92 was switched to Mode L/v at 02:33 UTC and will remain in that mode for 24 hours. Uplink is 1267.359 MHz, downlink is 145.880 MHz.



KO4MA @glasbrenner · 21h

AO-92 in Mode L/v at 0233UTC, and will revert back to U/v in 24 hours



5

10



Robert KE4AL @KE4ALabama · Nov 13

With a “feels like 22°F” today, this is how I felt...

#amsat



5

6

49



Some Memorable QSO's



1. My first “pile-up” via AO-92 (11/18/19) – <https://twitter.com/joedom/status/1196483799485485063>
2. Real QSO via AO-92 late at night (10/22/19) = <https://twitter.com/i/status/1186496660605718528>
3. Talking with Section Manager & friend AG4ZR (11/14/19) = <https://twitter.com/joedom/status/1195021656575684613>
4. My favorite -> contact with Myla via AO-85 (10/27/19) – <https://twitter.com/joedom/status/1188586803588153350>



Some general tips



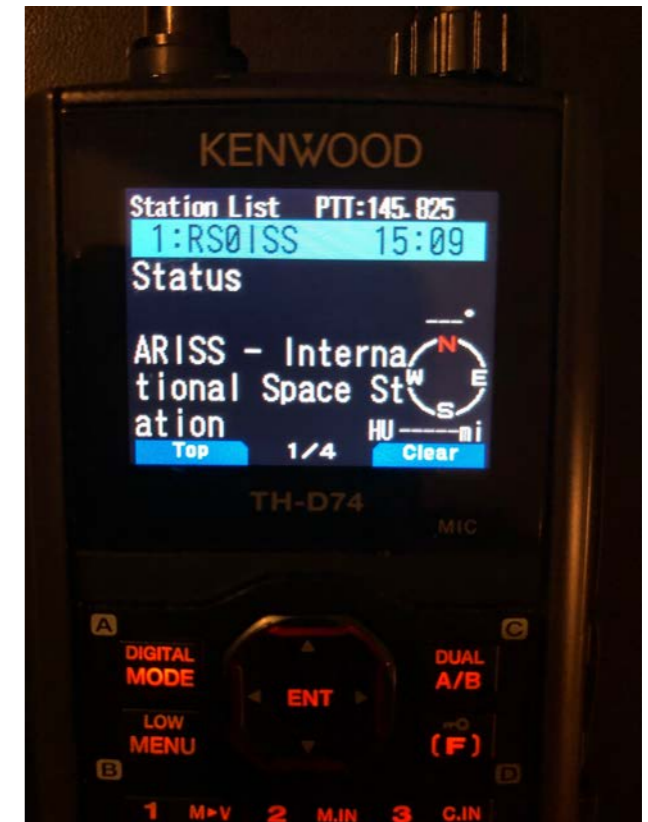
1. Plan your passes ahead of time
2. Use an app to be alerted about passes
3. Look for high passes (easier)
4. Look for low passes (greater DX)
5. Use two radios so you can hear your TX
6. Fully open the squelch on the RX
7. Use a handheld Yagi for best TX / RX
8. Use a record function so you can listen later
9. Don't call CQ, just callsign and grid
10. Share the satellite and don't hog the pass
11. Run low power, 5w is all you need!
12. If you can't hear it, don't work it
13. Log your contacts & confirm your QSO's
14. Consider sending QSL cards – AMSAT folks love 'em
15. Interact with the AMSAT community (web, social media, hamfests)



Other satellite topics



- APRS and packet
- Linear birds – SSB / CW
- Decoding telemetry
- Grid chasing / awards
- Work the ISS
- SSTV decoding
- Setting up a “sat shack”
- Complex antennas
- Supporting AMSAT
- and more!



***Consider supporting the non-profit Amateur Radio Satellite Corporation (AMSAT)
to help keep the birds in space and launch more***

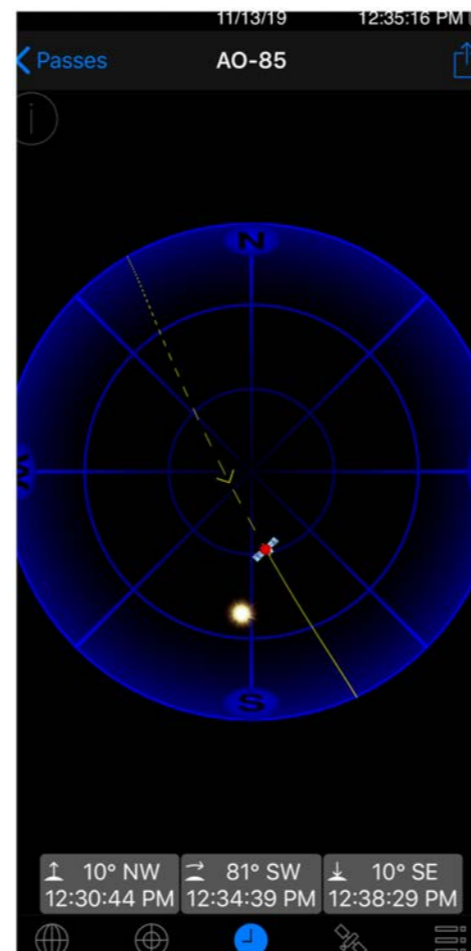
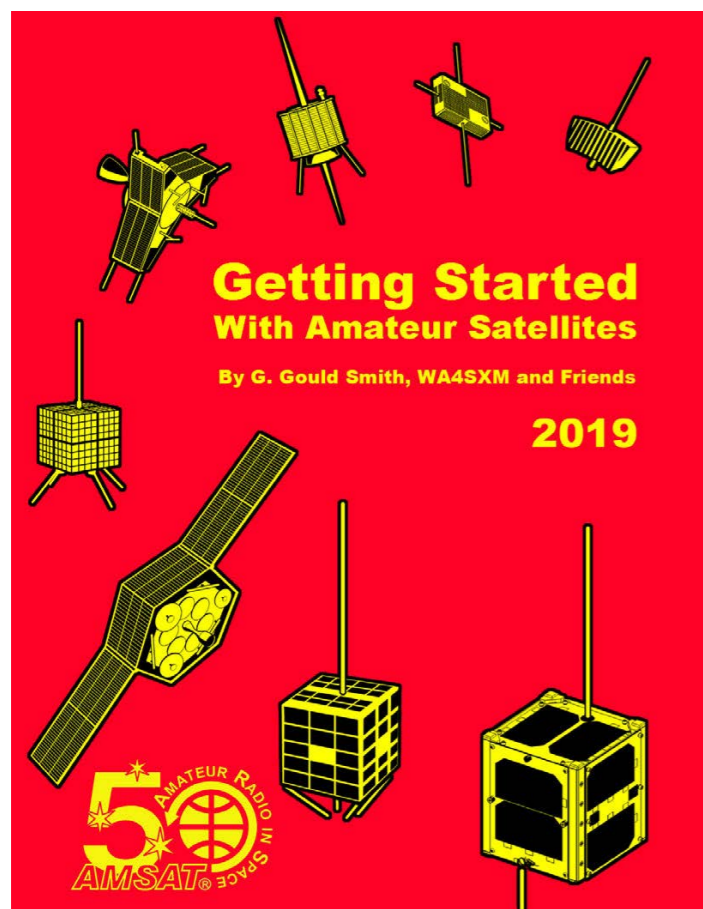
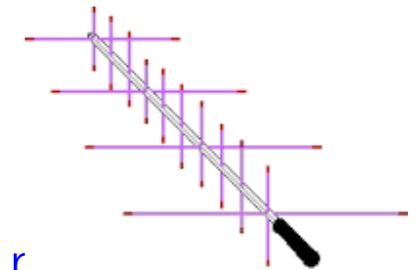
I am AMSAT member #41409

<https://amsat.org>

Suggested resources



1. *Getting Started with Amateur Satellites* (2019) by G. Gould Smith, WA4SXM
2. <https://amsat.org> - the definitive website for amateur radio satellites
3. <https://heavens-above.com> - great resource to find satellite passes
4. <https://twitter.com> - where all the AMSAT “cool kids” hang out
5. Facebook Group - <https://www.facebook.com/groups/AMSATNA/>
6. AMSAT-BB mailing list - <https://www.amsat.org/amsat-new/tools/maillist/maillist.r>
7. AMSAT DMR net – Wed. nights @ 2200 (ET) on TG 98006 BM.
8. Arrow Antennas – manufacturer of hand-held, dual-band
9. Satellite tracking apps – Heavens Above, GoSatWatch, AMSAT Droid, SatSat, ISS Tracker
10. Ham radio magazines (ham sat columns) – QST, CQ Amateur Radio, Spectrum Monitor



Acknowledgements



- WA5KBH – George Carr, my first satellite QSO
- WE4B – Jeff Johns (and Myla), one of my new found AMSAT friends
- K5DCC – Denny Johnson, another new found AMSAT friend and podcaster
- KO4MA – Andrew Glasbrenner, AMSAT VP Ops and source material
- K1SG – Steve Green, providing source material for this presentation
- N8HM – Paul Stoetzer, AMSAT Exec VP and source material
- KE4AL – Robert Bankston, AMSAT Officer and helpful ham
- AB1OC & AB1QB – Fred & Anita Kemmerer, picture for this presentation
- W5PFG & KK4YEL – Clayton Coleman & Kevin Zari, pictures for this presentation
- WD9EWK – Patrick Stoddard, AMSAT board member and one of the most helpful hams I know
- KI4HHI – Mrs. D, my favorite ham radio chick!



Lake Charles, Louisiana USA
WA5KBH
 Honoring fifty-five years as a ham radio operator

LOUISIANA
 Calcasieu Parish - Grid EM30
WA5KBH
 EX - G0WEW

loosed to
 & your first
 ham radio
 contact.
 73.
 George

Jeff
 Max!

CONFIRMING QSO WITH	DATE	UTC	MHz	RST	MODE 2-WAY	QSL
KI4ASK	28 Sept 2019	2015	14.5-435.2	59	FM	PSE TNX

10-10#37216 SMIRK#6231
 SIX CLUB#202 AMSAT#21199
 ARLHS#1269

SAT: BOYS POTA

GEORGE CARR
 2658 East Levingwood Rd.
 Lake Charles, Louisiana 70611 USA

E-mail: wa5kbh@arrl.net

About the speaker



- Husband, father, business owner, and donut connoisseur
- Lifelong radio aficionado
- Amateur Extra class license KI4ASK
- GMRS license WRCL957
- ARRL Assistant Section Manager for Georgia Section
- Past-president of the Fayette County Amateur Radio Club
- Volunteer Examiner – ARRL VE, Laurel VEC, W5YI-VEC, W4VEC
- Member of ARRL, ARES, and AMSAT #41409
- Enjoys public service – Special events, EmComm, Skywarn, CERT, ARES, AUXC
- Enjoys mobile operations – QRP, SOTA, Fox hunting, and (of course) AMSAT
- Married to KI4HHI

