

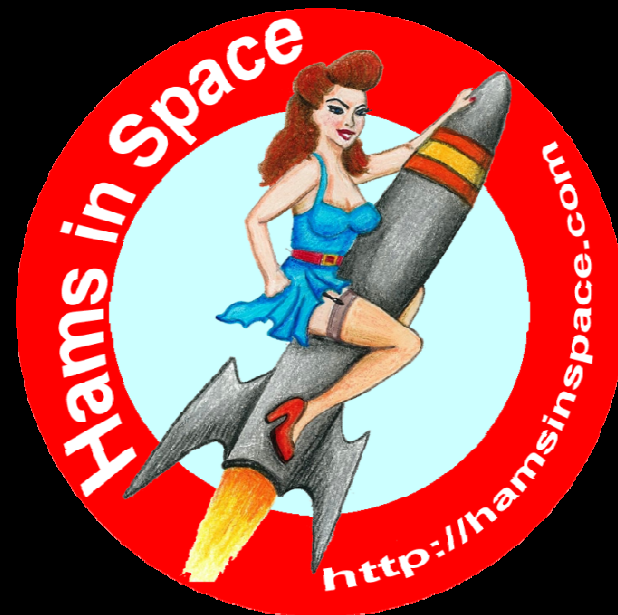
# Amateur Radio Satellites

Exciting Communications made Fun and Easy!

A Presentation by Hams in Space!

<http://hamsinspace.com>

Copyright ©2014 Randal R. Schulze dba Hams in Space  
v.7.0.6 May 3, 2014 Dayton



# Hams in Space

# Randy Schulze – KDØHKD

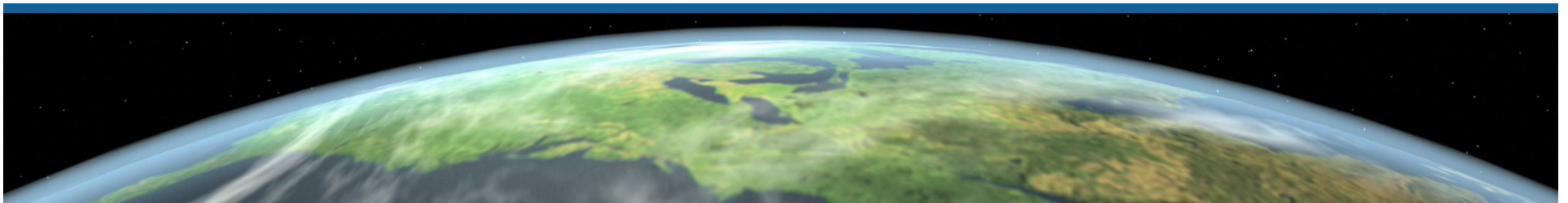
- Licensed as Technician – April 2009
- Upgraded to General – October 2009
- Upgraded to Extra – November 2012
- Grew up in Kearney, Nebraska
- Attended University of Nebraska, Kearney
- And Dana College, Blair, Nebraska
  - Majored in Radio Broadcasting
- Third Class Radio-Telephone Operator
  - Commercial FCC License
- Public Safety / 911 Communications Operator
- Police Officer
- Telecommunications Software Engineer
- IT Applications Development Coordinator
- Interests Include:
  - Amateur Radio
  - Playing Guitar
  - Fishing



**Hams in Space**

**Randy Schulze – KDØHKD**

***Active Member of the  
Raytown Amateur Radio Club,  
Raytown, Missouri***



# Hams in Space

# Eddy Paul – KYØF

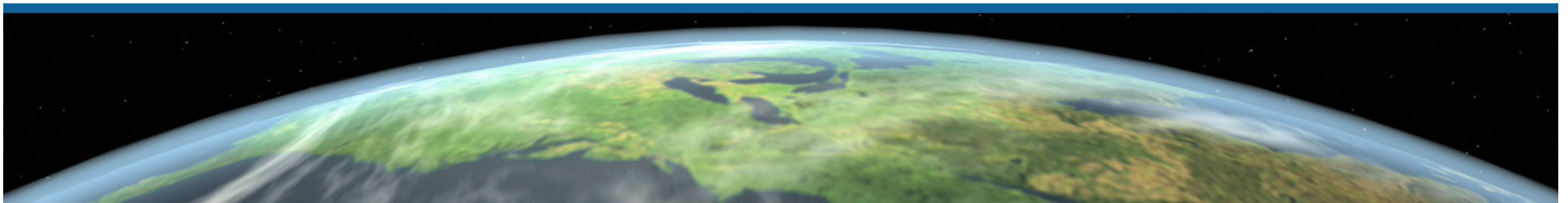
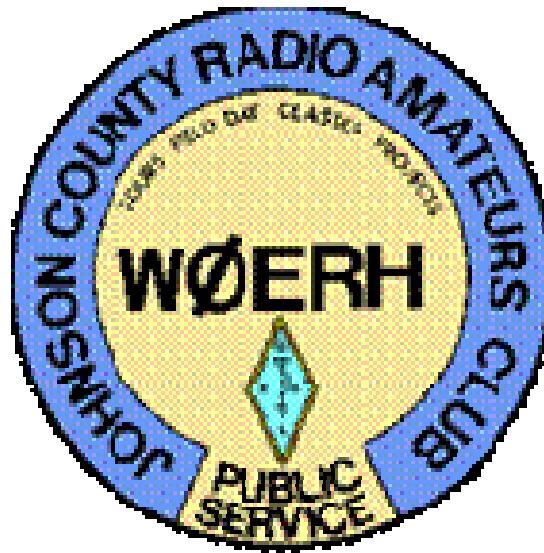
- Licensed as Technician – June 2009
- Upgraded to General – June 2009
- Upgraded to Extra – March 2010
- Grew up in Louisiana
- Southeastern Louisiana University
  - BA Business Administration & Accounting
- Officer; United States Army Signal Corp
- Computer Programmer Louisiana Department of Revenue
- 25 Years Management with a Major Telecommunications Company
- Interests Include:
  - Remote Control Airplanes
  - Cowboy Action Shooting
  - Amateur Radio
  - Fishing



**Hams in Space**

**Eddy Paul – KYØF**

***Active Member of the  
Johnson County  
Radio Amateurs Club,  
Overland Park, Kansas***



# Hams in Space

# Jeremy Widner – ACØDX

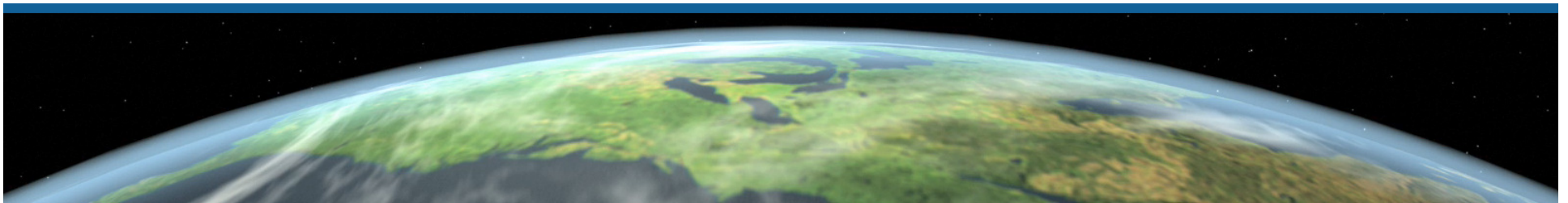
- Licensed as Technician – April 2009
- Upgraded to General – September 2009
- Upgraded to Extra – September 2012
- Grew up in California
- York College, York Nebraska
  - General studies
- 13 Years Systems Engineer with a Major Telecommunications Company. Now Software Tools Consultant, working nationwide.
- Interests Include:
  - Huskers Football
  - Fishing
  - Amateur Radio
  - Youth Ministry



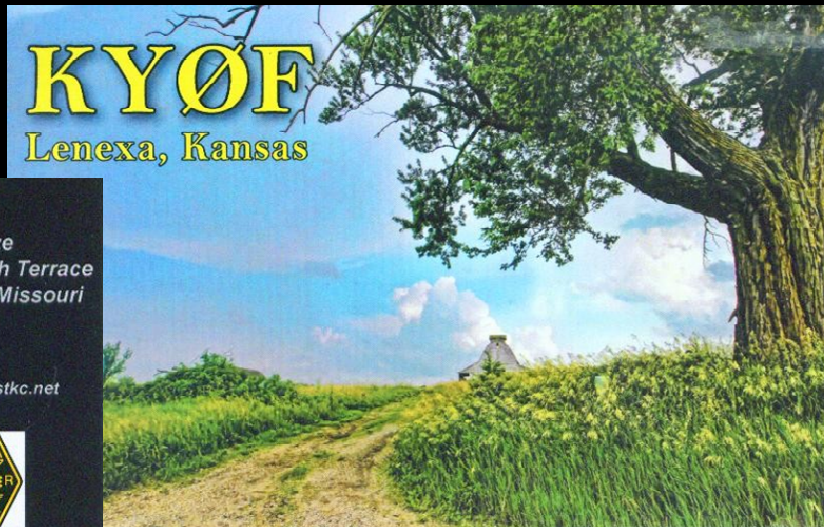
**Hams in Space**

**Jeremy Widner – ACØDX**

***Active Member of the  
Raytown Amateur Radio Club,  
Raytown, Missouri***



# Hams in Space





**KDØHKD**  
 EM28qw, Kansas City, Missouri, USA

Randy Schulze  
 500 East 105th Terrace  
 Kansas City, Missouri  
 64131-4333  
 USA  
 KDØHKD@everestkc.net




Confirming QSO With:

Day	Month	Year	UTC	MHz	RS

**ACØDX**

**Jeremy Widner**  
 11300 East 77th Terrace  
 Raytown, MO 64138  
 U.S.A.  
 Jackson County • Grid EM28sx  
 Email: k0pdx@arrl.net





*Hams in Space*

Contact Us

- All of us can be contacted at:

***Hams In Space***

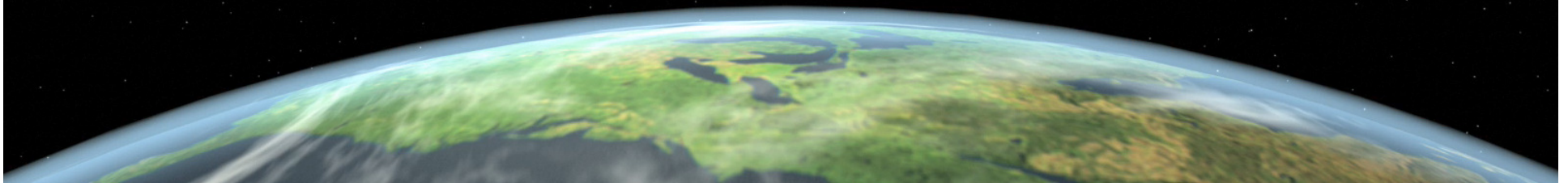


<http://hamsinspace.com>  
c/o 500 East 105th Terrace  
Kansas City, Missouri 64131

***KD0HKD Randy Schulze***  
[kd0hkd@everestkc.net](mailto:kd0hkd@everestkc.net)

***KY0F EddyPaul***  
[ky0f@arri.net](mailto:ky0f@arri.net)

***AC0DX Jeremy Widner***  
[jeremyrwidner@gmail.com](mailto:jeremyrwidner@gmail.com)

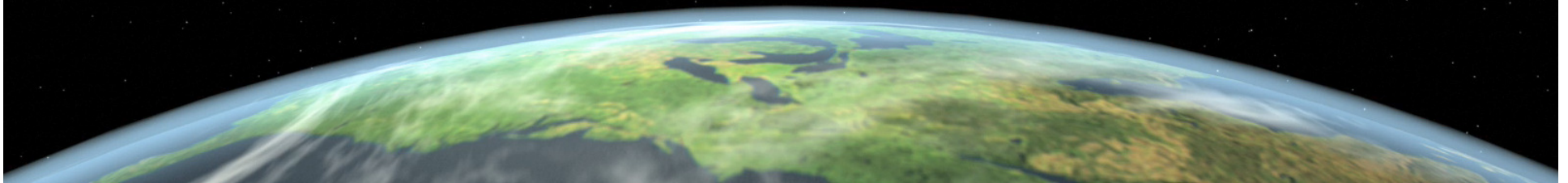


# We Are Providing Our Experience!

**Hams in Space** provides instruction, and represents the opinions of Randy Schulze, Eddy Paul, and Jeremy Widner based on our experience of success and failures in the art and science of amateur radio. Although we may refer or defer to other people or organizations, we are not representatives of, nor do we speak for or on the behalf of any other organization. While we might mention equipment and / or brand names of products, equipment, hardware, or software we may have used or have experience with, we do not make or imply the endorsement of such items, nor have we sought out, nor have we accepted any offers, paid or otherwise, from any manufacturer or vendor of such items to endorse or promote their products.

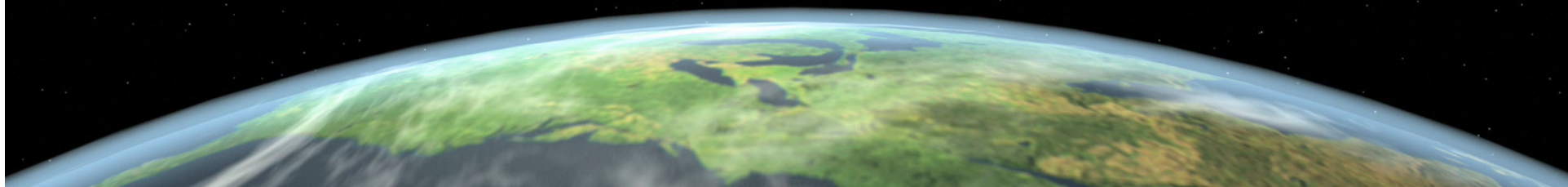
While we admit we may have a bias, like or dislike for something we've tried out based on our experience, or based on what we can financially afford, these are solely our personal opinions that we share with you.

***In short; no one is paying us to put their words in our mouths.***



# We Are Not Experts!

- We're just having fun working satellites. Part of that fun, is we're still learning something new, all the time.
- We have just scratched the surface of what can be done with Amateur Radio Satellites. So far, we've been working the FM "Birds." There are also satellites which work SSB on 10m, others that work CW, and some that work in the microwave bands.
- Work the mode that most interests you.
- *Have Fun!*



# History: *OSCAR, the 1<sup>st</sup> Amateur Radio Satellite*

**OSCAR: *Orbiting Satellite Carrying Amateur Radio***

Project OSCAR started in 1960 and was responsible for the construction of the first Amateur Radio Satellite OSCAR-1, that was successfully launched from Vandenberg AFB in California, on December 12, 1961, barely four years after the launch of Russia's first Sputnik. OSCAR-1 orbited the earth for 22 days, transmitting the "HI" greeting in Morse Code from above.



# Good News! *AMSAT Has Announced a Launch Date for the FOX-1 Amateur Radio Satellite!*

## Fox-1 may launch during Summer 2015

The Fox-1 Satellite will contain state of the art communications and battery technology in an amazingly small package. Jeremy is holding an exact scale mockup on display at the AMSAT Booth during the Dayton Hamvention, May 2013.

[http://ww2.amsat.org/?page\\_id=1113](http://ww2.amsat.org/?page_id=1113)



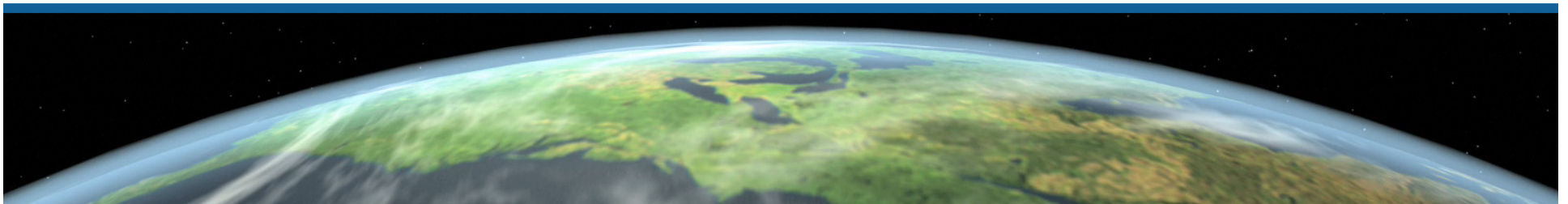
# What Attracted Us to Amateur Radio Satellites?

- First Learned of Amateur Radio Satellites from the Audio CD with Gordon West's Study Guide for Technician Class.
- Became very interested while listening to the Clint Bradford – K6LCS Presentation on K0GQ Technology Net, September 11, 2009.
- Successfully tuned in (received only) the SO-50 Satellite with an HT and the standard, out-of-the-box antenna.
- Randy made his first, successful, two-way contact via the AO-51 Satellite on November 1, 2009.



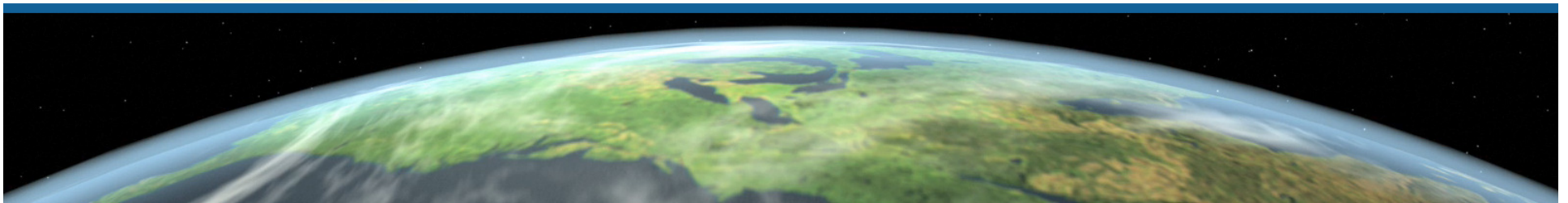
# Randy's Results

- *Over the next two and a half months, I logged over 38 successful contacts, 27 of which were confirmed by QSL Cards including 19 US States, 1 Canadian Province, and 1 Mexican State!*



# Randy Earned Three Awards:

- **The OSCAR Satellite Communications Achievement**
  - Contacts with 20 different U.S. states or Canadian call areas or DXCC countries
- **The South Africa AMSAT Satellite Communications Achievement Award**
  - Working 25 different stations on phase 2 satellites. Satellites
- **QRP All States Award**
  - Successful two-way communication with 20 of the United States of America while running a power output of 5 Watts or Less





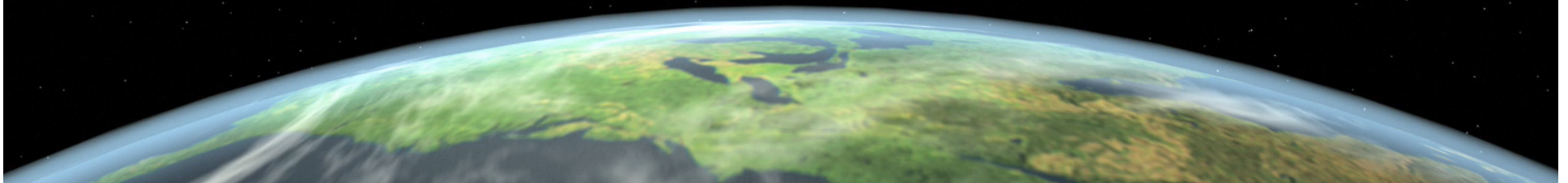
# How We Work Amateur Satellites!

- Everyone may have their own style or method of working the Amateur Satellites.
- Although what we're doing with our equipment works very well for us, it is certainly not the *only way* to work satellites.
- There are various combinations of antennas and radios that can be very successful.



## Power Should Not Be an Issue!

- You do not need very much power to work Amateur Radio Satellites.
- The best, and most cost effective way to improve your performance, is by using a better antenna. *This can not be overstated!*



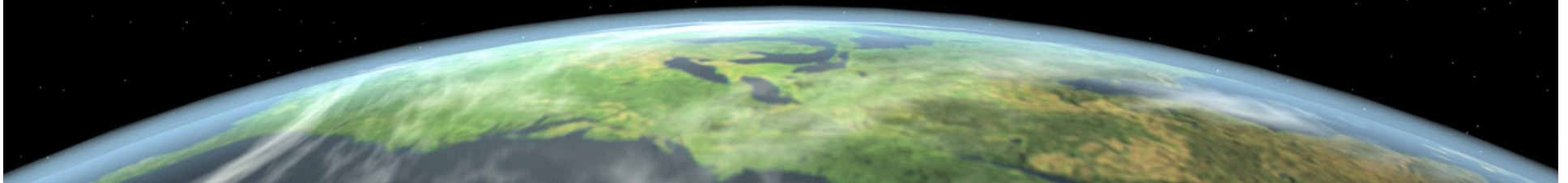
# A Short Word About Protocol

- Option One: General Call Out:
  - *“KD0HKD; EM28; Handheld; Missouri!”*
- Option Two: Specific Call Out:
  - *“KY0F; (This is) KD0HKD; EM28; Handheld; Missouri;”*
- As a courtesy, “more powerful” stations should yield to you as a Handheld.
- DO NOT call out *“CQ, CQ, CQ, Satellite!”* In this arena, this is considered a very serious breach of etiquette!



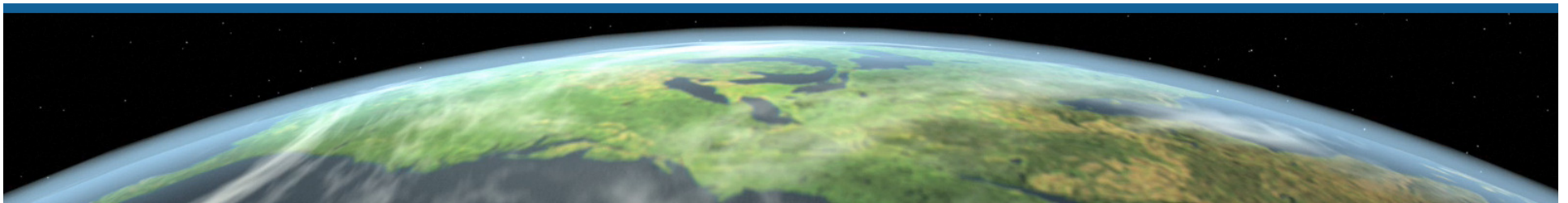
# Some Basic Tools In Our Bag of Tricks!

- **Radio**
  - 5 Watt (or less) Dual-Band, Hand Held HT Radio
- **Antenna**
  - Hand Held Yagi Antenna, or
  - After Market HT Whip
- **Voice Recorder**
  - Digital or Tape Recorder
- **Satellite Prediction Software**
  - For PC Computer:
  - For PDA Running or Smart Phone
- **A Simple Compass**



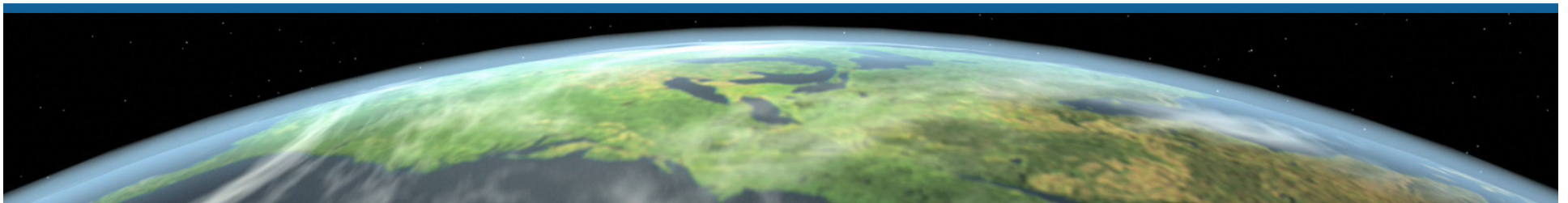
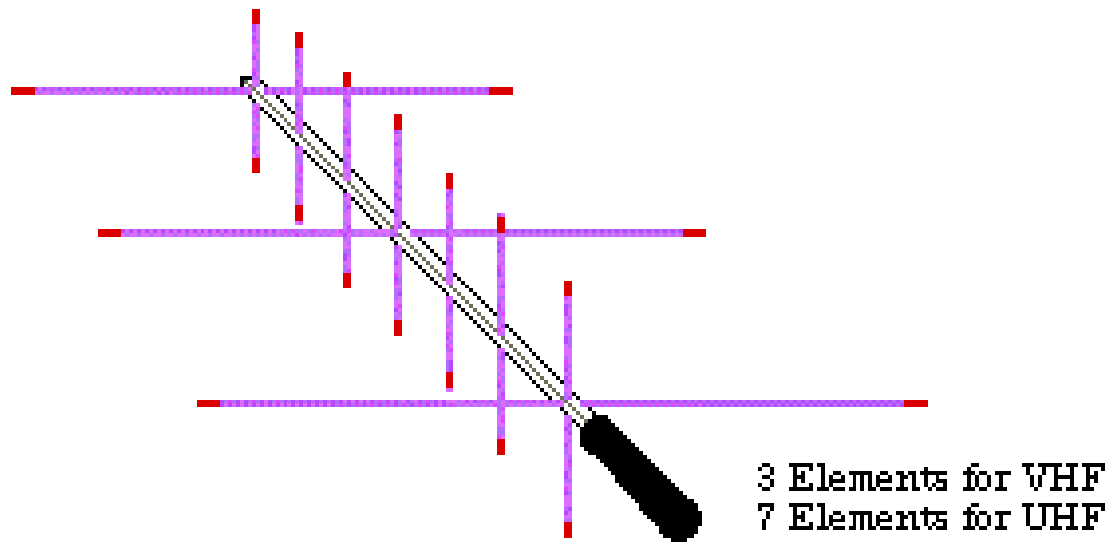
# Radio: Yaesu FT-60R Hand Held

- Capable of “Cross-Band” Operation. i.e. Transmit on UHF while Receive on VHF or visa versa.
- Up to 5 Watts Transmit Power
- Relatively low cost.
- Easy to connect to various antenna options.
- ADMS Channel Programming software is available, and highly recommended.



# Antenna: Arrow II LEO Hand Held Antenna

- VHF – UHF Yagi
- Most expensive option with all the features costs less than \$150.00 retail.
- Easy to assemble / Easy to use.



# Antenna: After Market HT Whips

- VHF – UHF After Market Antenna for Hand-Held
- Prices vary, but you will get what you pay for!
- Most aftermarket whips are very good antennas. Works not only for Satellite, but are excellent for general hand-held use.



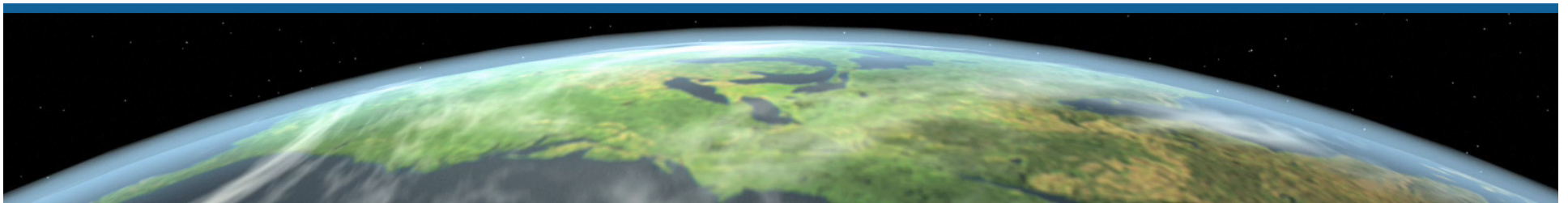
Pryme  
AL-800



Smiley 270A



Diamond  
SRH 320A



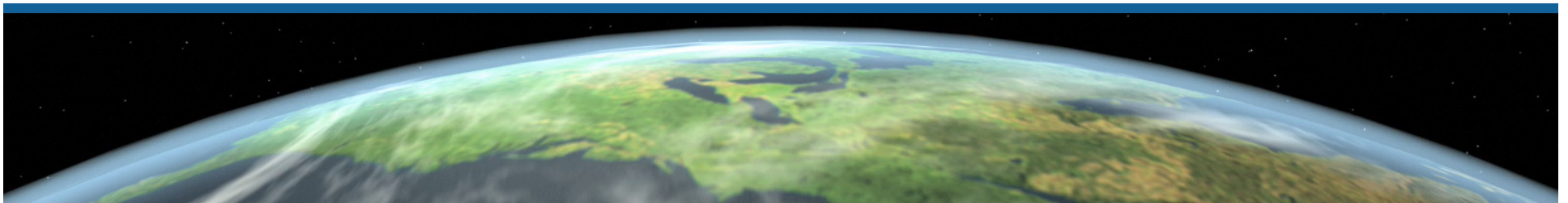
# Voice Recorder

**A recorder is recommended in lieu of writing notes to capture call signs, grid squares, etc.**

- Digital Voice Recorder
- Time / Date Stamp for each recording
- Comes with software for loading recordings to computer as MP3 Files
- Cost is about \$60 at Target or Walmart
- May be worn on a lanyard or clipped to a belt or pocket for ease of use



Sony  
ICD PX-270

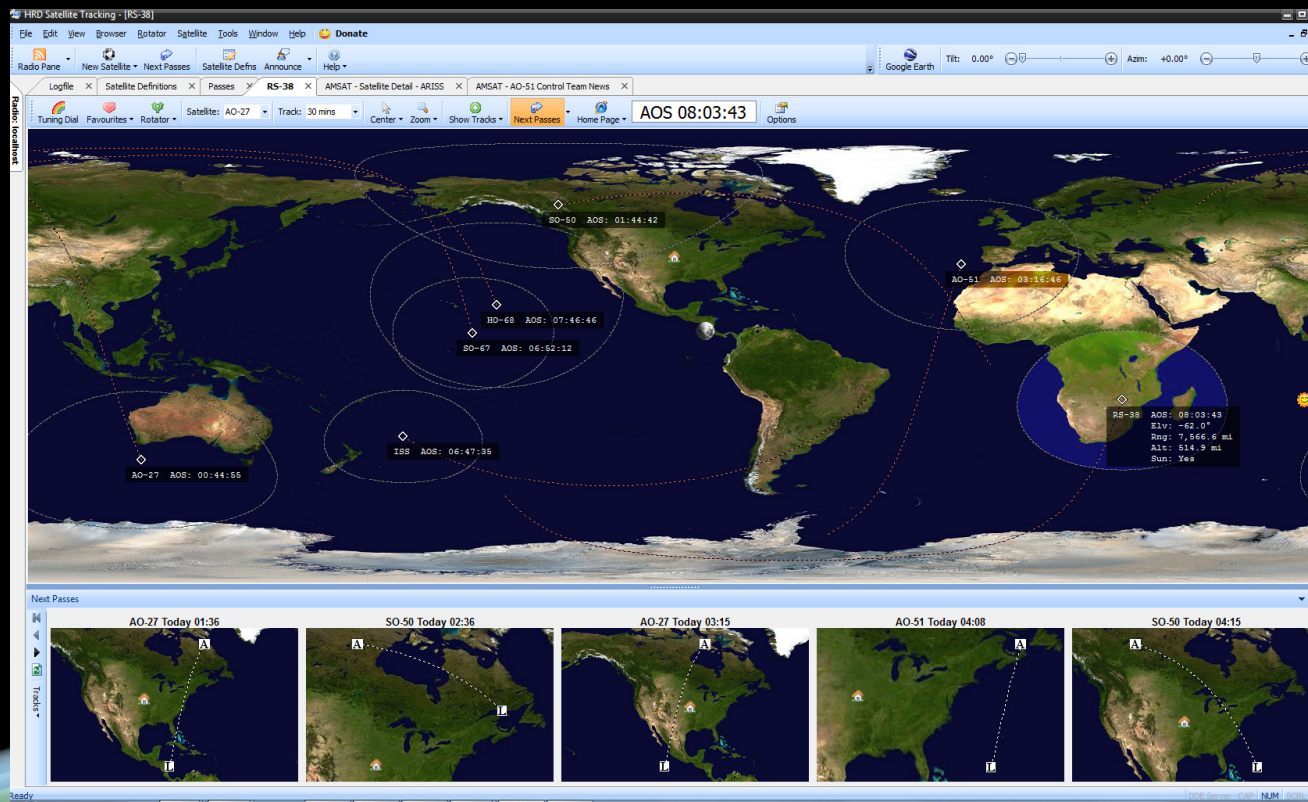




# Prediction Software:

## Ham Radio Deluxe (HRD)

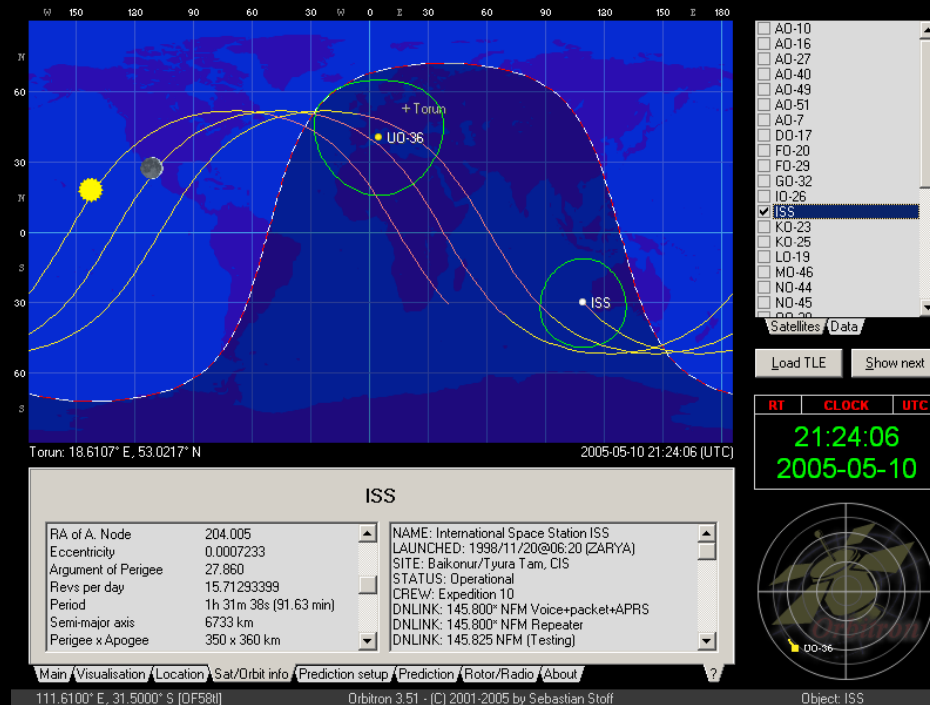
- Version 5.x is Free of Charge / Version 6.x Requires a License.
- Keeps Keplerian Data current via the Internet.
- Displays as many (or as few) satellites as you would like.
- Has *many* of the features enjoyed by satellite users.



# Prediction Software:

## Orbitron

- For radio amateur and observing purposes. It's also used by weather professionals, satellite communication users, astronomers, UFO hobbyist and even astrologers.
- Application shows the positions of satellites at any given moment (in real or simulated time).



<http://www.stoff.pl/>

# Prediction Software:

## HamSatDroid:

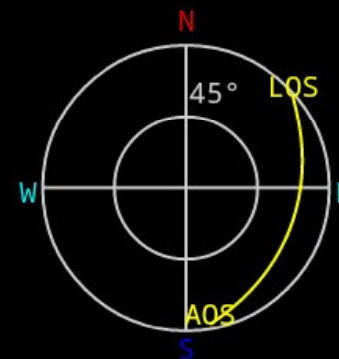
This software predicts future passes for amateur radio satellites for a specified location and period of time. It runs on the Android operating system (v 1.5 and above).

## Features:

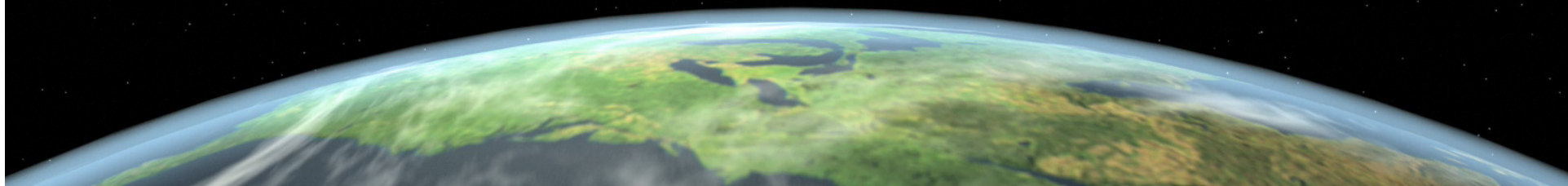
- Calculate passes for up to the next 24 hours
- Graphical pass display
- Map view showing current satellite position
- Update keps from a file on SD card or directly from AMSAT's webpage using your phone's internet connection
- Set home coordinates from Network or GPS



Date: April 21, 2011  
Start Time: 8:52 PM  
Duration: 11 min  
AOS Azimuth: 170°  
Max Elevation: 20°  
LOS Azimuth: 45°



<http://sites.google.com/site/hamsatdroid/home>



# Prediction Software:

**AMSAT Online Satellite Pass Predictions - AO-51**  
[View the current location of AO-51](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
31 Jan 10	09:36:58	00:13:30	133	24	76	2	09:50:28
31 Jan 10	11:15:06	00:14:30	186	38	272	339	11:29:36
31 Jan 10	21:46:55	00:08:49	47	6	89	127	21:55:44
31 Jan 10	23:23:53	00:13:59	13	78	73	191	23:37:52
01 Feb 10	01:03:48	00:10:40	348	10	307	248	01:14:28
01 Feb 10	08:59:25	00:10:54	109	10	68	12	09:10:19
01 Feb 10	10:35:28	00:14:53	165	88	67	348	10:50:21
01 Feb 10	12:16:54	00:10:57	223	9	264	320	12:27:51
01 Feb 10	22:44:45	00:13:08	24	29	80	168	22:57:53
02 Feb 10	00:23:43	00:12:49	359	25	301	225	00:36:32

**Your results are shown above**  
 Use the form below to request more pass predictions

Show Predictions for:  for Next  Passes

Calculate Latitude and Longitude from Gridsquare:

*Or*

Enter Decimal Latitude:\*

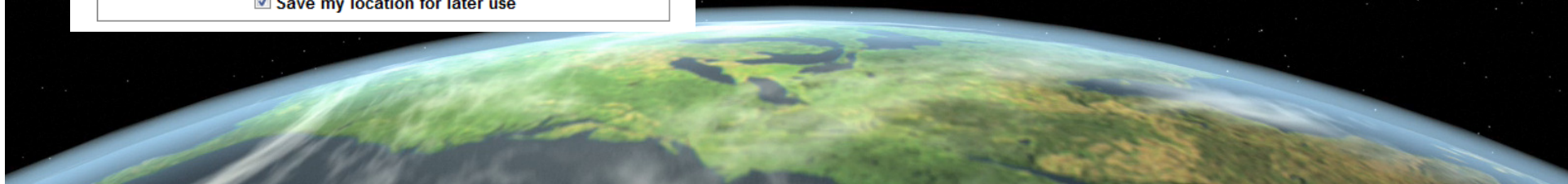
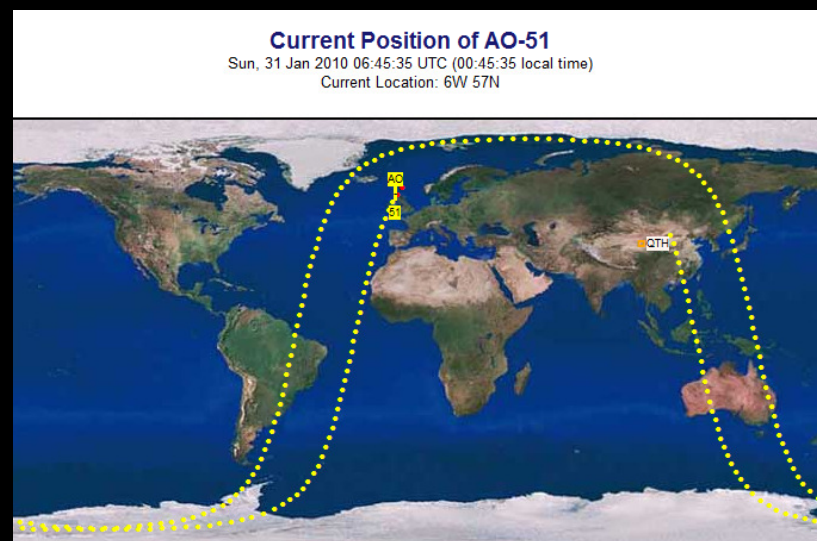
Enter Decimal Longitude:\*

Elevation (Metres):

Save my location for later use

## AMSAT Web Site

- Available on the internet to anyone.
- Data elements are always current.
- Only displays one satellite at a time.

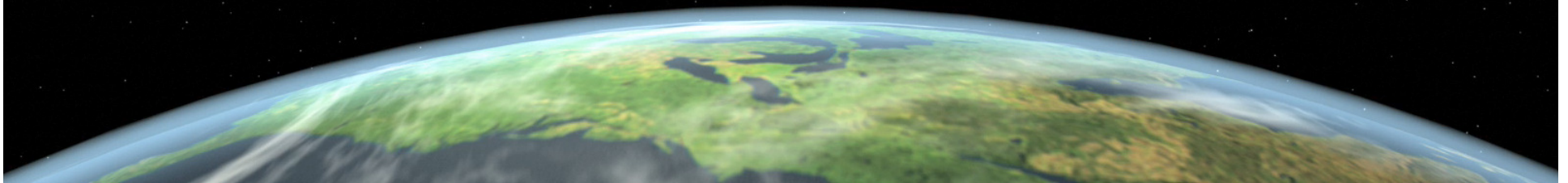


# Tuning or Programming the Radio for: SO-50

**Note: The Downlink, or Receive Frequency is at 5 KHz intervals to account for Doppler Shift. Also Note: CTCSS Tones.**

Receive Frequency	Transmit Frequency	Offset Frequency	Offset Direction	Operating Mode	Name	Tone Mode	Tone
436.81500	145.85000		Split	FM	50 +4	Tone	67.0 Hz
436.81000	145.85000		Split	FM	50 +3	Tone	67.0 Hz
436.80500	145.85000		Split	FM	50 +2	Tone	67.0 Hz
436.80000	145.85000		Split	FM	50 +1	Tone	67.0 Hz
436.79500	145.85000		Split	FM	50 MID	Tone	67.0 Hz
436.79000	145.85000		Split	FM	50 -1	Tone	67.0 Hz
436.78500	145.85000		Split	FM	50 -2	Tone	67.0 Hz
436.78000	145.85000		Split	FM	50 -3	Tone	67.0 Hz
<i>436.79500</i>	<i>145.85000</i>		<i>Split</i>	<i>FM</i>	<i>50 74</i>	<i>Tone</i>	<i>74.4 Hz</i>

*What's this thing with the 74.4 Hz tone?* That actually turns the radios in the satellite on! In the rare event that SO-50 comes over the horizon, and no traffic is heard, transmit this tone for about 2 seconds. This will turn the radios on. If there is no traffic detected for ten minutes, the radios will shut off. This saves battery power.



# Hams in Space



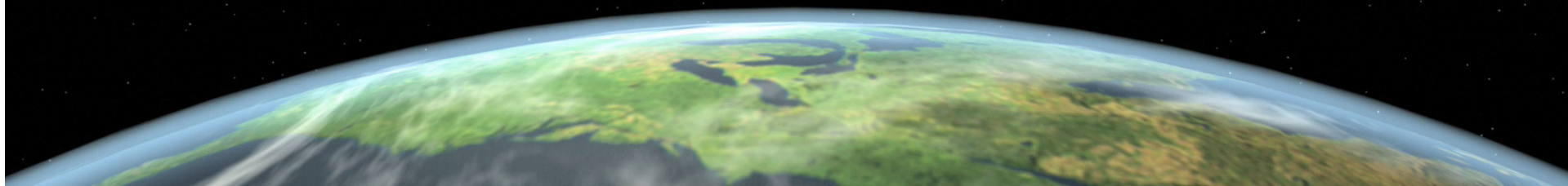
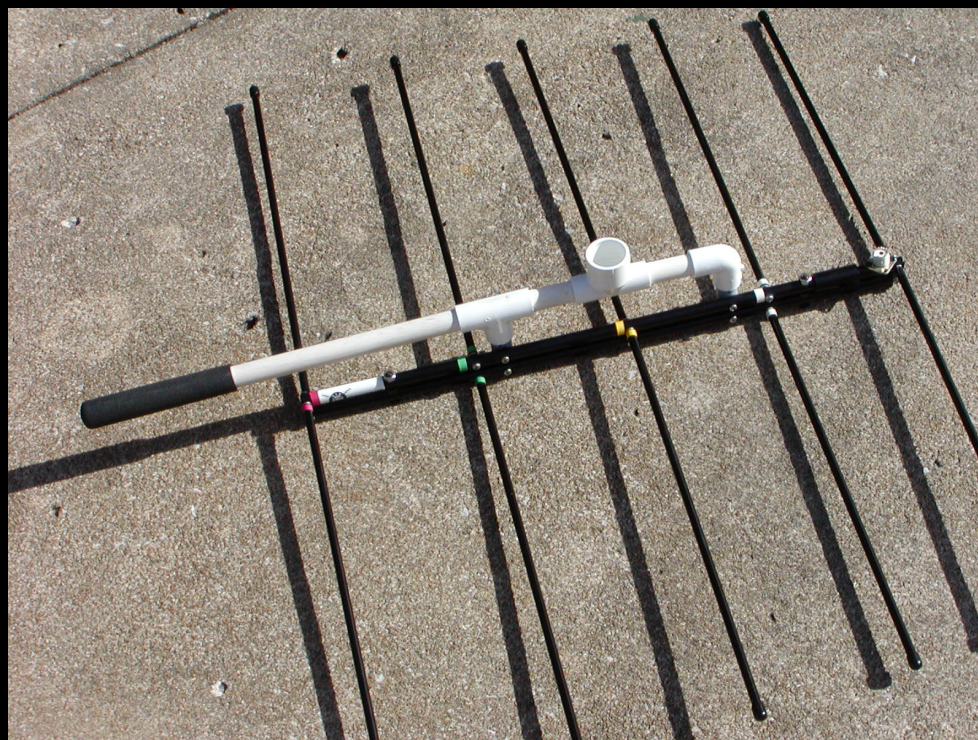
# Gadgets!



# Antennas:

## Elk Model 2M/440L5 Five Element, Log Periodic Antenna

- Pros:
  - No Diplexer Required for 145 Through 440 MHz
  - Strong Clear Signal
  - Sturdy, Well Built Construction
- Cons:
  - Heavy
  - Requires More Precision
  - Handle Could be Better Engineered
- Available from:  
<http://www.elkantennas.com>



# Antennas:

## Stephen Gulyas BNC-to-SMA Adapters

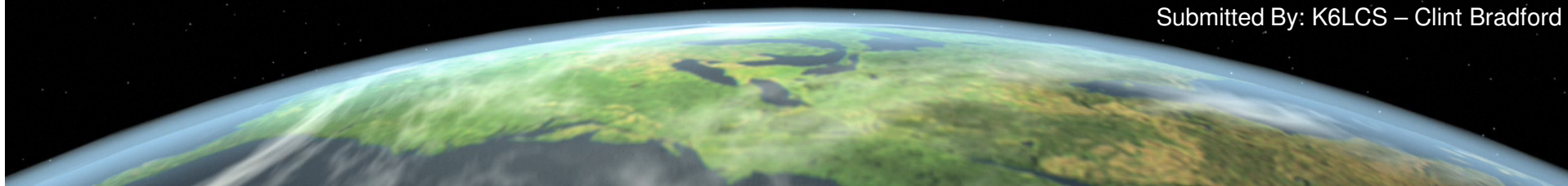
- **Pros:**
  - TRUE protection of your HT's antenna connector
  - Not "one size fits all" - several models for different HTs
- **Cons:**
  - Only available from Stephen - no big store carries them, yet.
  - Cost - but compare with a \$100 bill to repair you HT's broken antenna center pin connector, and the cost is nothing



Hard rubber displaces the stress placed on your HT when attaching larger antennas or cabling. These fine adapters "mate" to a much larger surface area on your HT than the "all-metal" CN3-like adapters. Click on the link above for a .pdf file with pictures, model numbers, and ordering instructions.

- Available from: [http://web.me.com/clintbradford/Work-Sat/Antennas\\_files/gulyas-011.pdf](http://web.me.com/clintbradford/Work-Sat/Antennas_files/gulyas-011.pdf)

Submitted By: K6LCS – Clint Bradford





# Antenna Rotator:

## Azimuth – Elevation (Az-El) Antenna Rotator System

- **Pros:**

- Ability to track your satellite pass from Horizon to Horizon.

- **Cons:**

- Prohibitively EXPENSIVE!
- *You Don't Need One*

If you really want a rotator for tracking across the horizon, use a single plane, (azimuth) rotator with a suitable antenna permanently affixed at 30 to 45 degrees elevation. This will provide superb performance for 95% of all satellite passes.

- The one pictured here is a Yaesu G5500:

<http://www.yaesu.com>

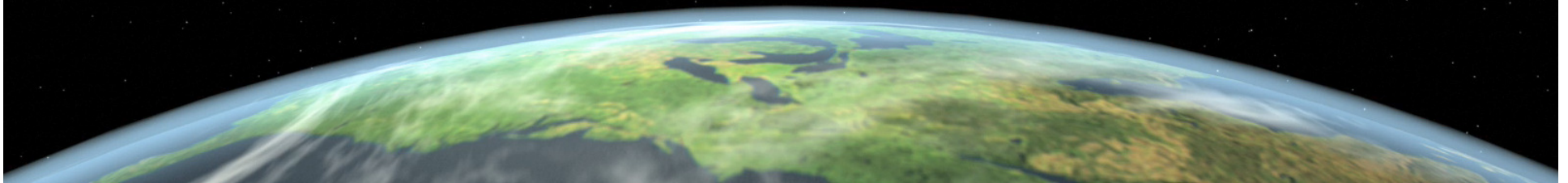
- \$589 for the Rotator, \$569 for the Computer Interface



# Radios – Hand Held:

## Yaesu VX-3R

- **Pros:**
  - Very Small, Light Weight, and Compact.
  - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
  - Difficult to program. (RDMS Software is available.)
- **Available from:**  
<http://www.associatedradio.com/>
- Really, any good HT, be it Yaesu, Icom, Kenwood, or whatever, so long as it is capable of “split-banding” and PL Tone will be more than satisfactory to work Satellites!



# Radios – Hand Held:

## Wouxun KG-UVD1P

- **Pros:**
  - Good value.
  - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
  - Output sounds a little “clipped.”
- **Available from:**  
<http://www.associatedradio.com/>

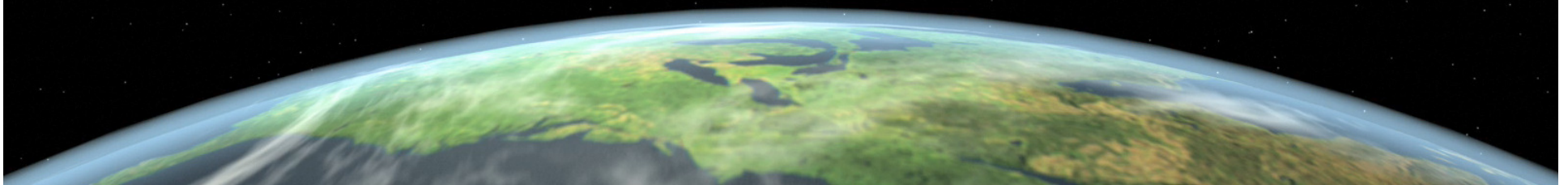
For the money, this is a great little radio! Comes with Programming Software and USB Cable, all in the same Package.



# Radios – Hand Held:

## Baofeng UV-3R

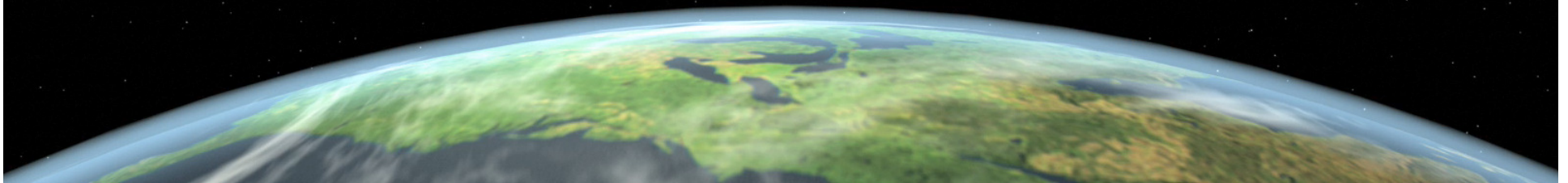
- **Pros:**
  - Good value. About \$50.00 Including Shipping
  - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
  - Programming Is Very Difficult, Even With Software
  - User Groups and Forums on the Internet
- **Available from:**
  - Several Outlets on the Internet
- For the money, this is a great little radio!  
It is very similar in form to the Yaesu VX-3R



# Radios – Hand Held:

## Baofeng UV-5R

- **Pros:**
  - Good value. About \$50.00 Including Shipping
  - Up to 5 Watts
  - With the right antenna, capable of successful amateur radio satellite communication.
- **Cons:**
  - Programming Is Very Difficult, Even With Software
  - User Groups and Forums on the Internet
- **Available from:**
  - Several Outlets on the Internet
- For the money, this is a another great little radio!



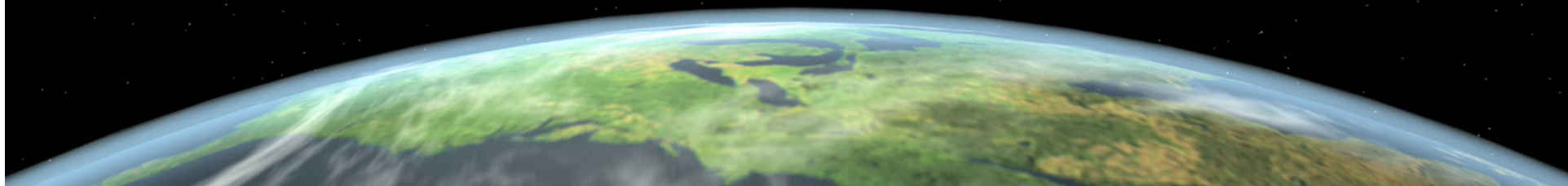
# Resources:

## Work-Sat

- This is the web site of Clint Bradford, K6LCS who is the AMSAT Coordinator for Southern California. He has an outstanding site, containing Satellite Schedules, Antenna Projects, Advice, and an outstanding blog. *This is a must have on the favorites list for any satellite aficionado!*
- <http://work-sat.com>

## Amateur Radio Satellites

- This web site was created by Allen Mattis, N5AFV of Houston, Texas. Not only does this site contain many other links and resources, Allen has also done a lot of study, trial and error, and observations on different antennas and antenna configurations for working amateur radio satellites. I found a lot of useful information here!
- <http://www.qsl.net/n5afv/>



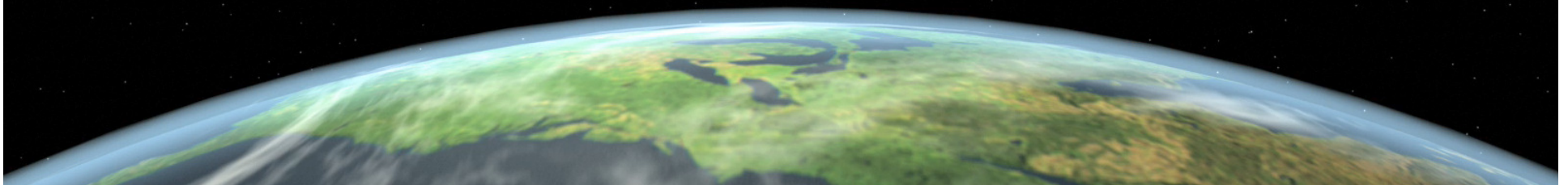
# Resources:

## A Resource for Working Amateur Radio Satellite

- This is the site of Kansas City's own Ron Nutter, KA4KYI, who is also one of AMSAT's Area Coordinators for Missouri. Ron provides some very good, basic advice for the new, as well as advanced satellite operator.
- <http://ka4kyi.com/>

## AMSAT

- The Radio Amateur Satellite Corporation or AMSAT is the mother-ship for all who are interested in Amateur Radio Satellites. Everything you need is right here!
- <http://www.amsat.org/>



# Putting All of This Together:

- Satellite

- Antenna

- Radio

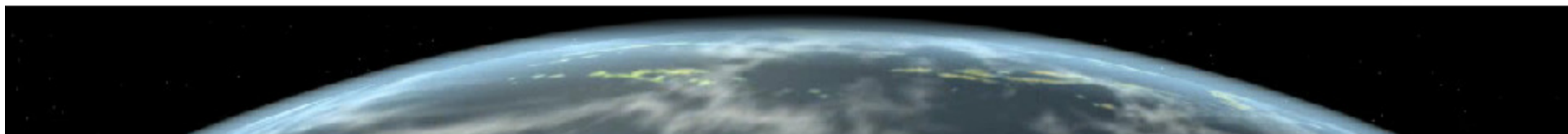
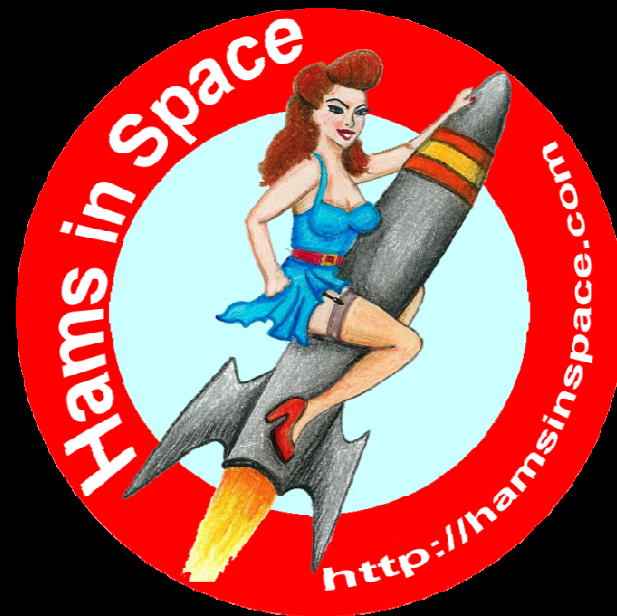
- Results

*Keep It Simple! Have Fun!*



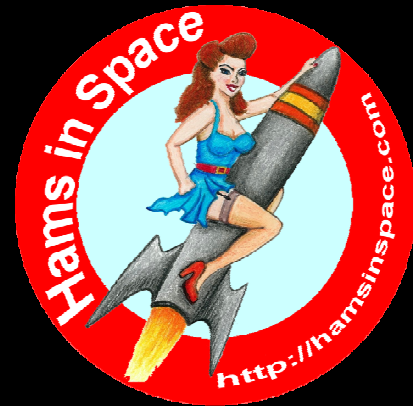


# Q&A



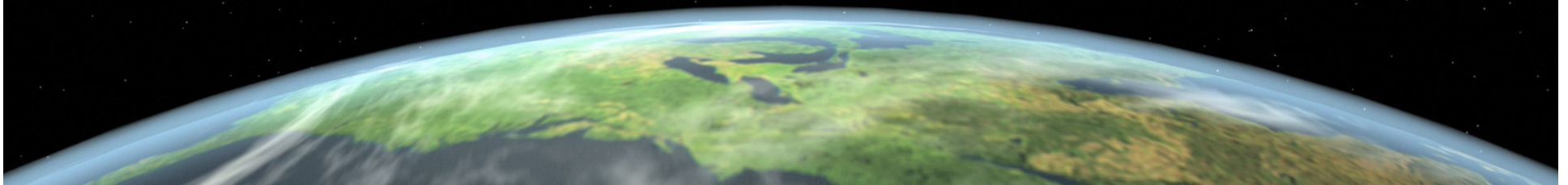
# Web Sites Mentioned in Our Presentation:

- **KD0HKD's Radio Web Site:**  
<http://kd0hkd.com>
- **KD0HKD's Satellite Web Site:**  
<http://kd0hkd.com/satellite>
- **AMSAT (Radio Amateur Satellite Corporation):**  
<http://www.amsat.org>
- **QRP Association:**  
<http://www.qrparci.org>
- **Arrow Antennas:**  
<http://www.arrowantennas.com>
- **Ham Radio Deluxe:**  
<http://ham-radio-deluxe.com>
- **Orbitron:**  
<http://www.stoff.pl/>
- **PockerSat+ :**  
<http://www.bigfattail.com/pocketsat/>
- **HamSatDroid:**  
<http://sites.google.com/site/hamsatdroid/home>



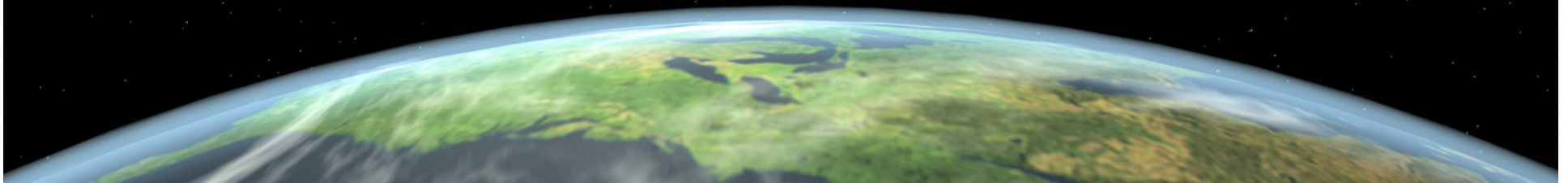
# Web Sites Mentioned in Our Presentation:

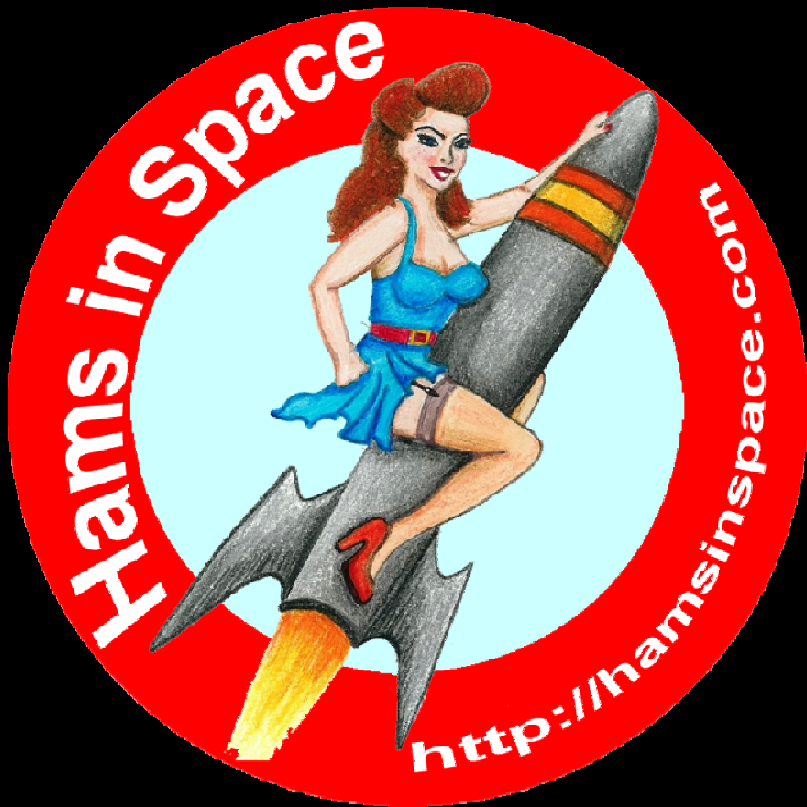
- **Elk Antennas:**  
<http://www.elkantennas.com>
- **Myers Engineering:**  
<http://www.antennas.us>
- **Smiley Antennas:**  
<http://www.htantennas.com>
- **Stephen Gulyas BNC-to-SMA Adapters :**  
[http://web.me.com/clintbradford/Work-Sat/Antennas\\_files/gulyas-011.pdf](http://web.me.com/clintbradford/Work-Sat/Antennas_files/gulyas-011.pdf)
- **Associated Radio:**  
<http://www.associatedradio.com/>
- **eBay:**  
<http://ebay.com>
- **Bass Pro Shops:**  
<http://www.baspro.com>



# Web Sites Mentioned in Our Presentation:

- **Cabella's:**  
<http://www.cabellas.com>
- **Harbour Freight:**  
<http://harbourfreight.com>
- **Clint Bradford, K6LCS Web Site:**  
<http://work-sat.com>
- **Allen Mattis, N5AFV Web Site:**  
<http://www.qsl.net/n5afv/>
- **Ron Nutter, KA4KYI Web Site:**  
<http://ka4kyi.com/>





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