AMSAT
Amateur Satellites For the 21st Century

AMSAT and Amateur Radio Benefits for the Cubesat Community

Presented by

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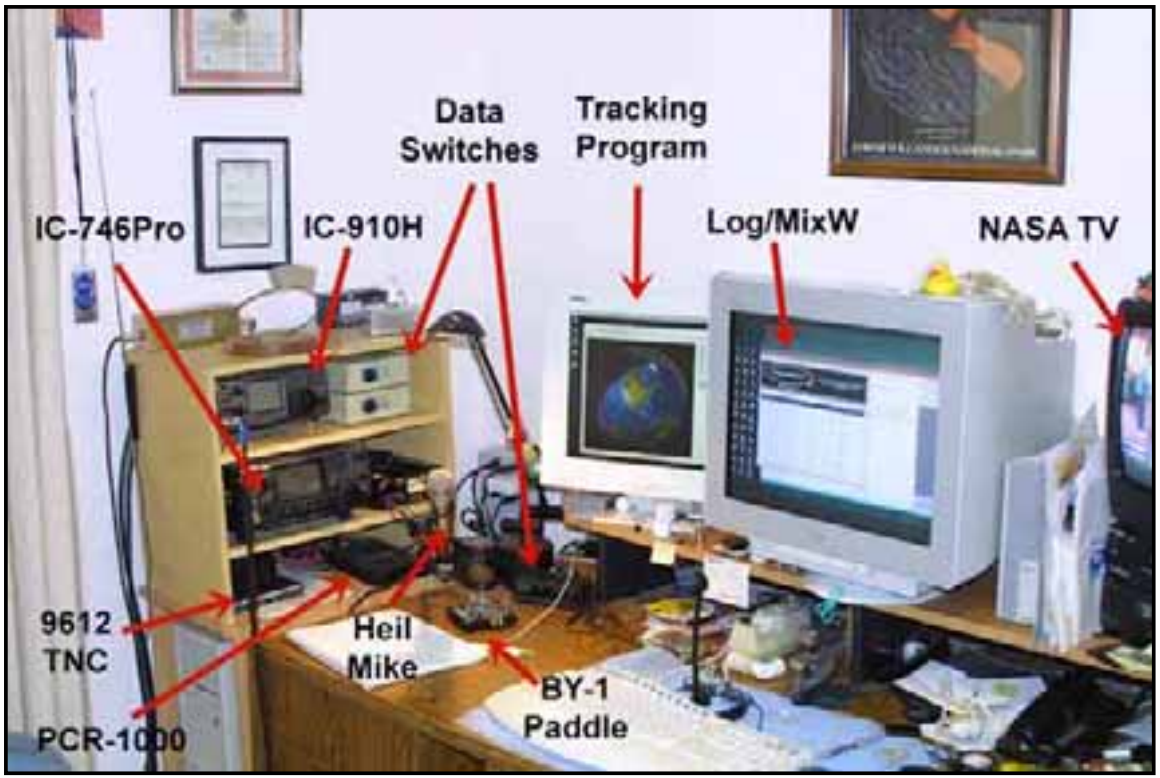
A Brief History of Amateur Satellites

- In the late 1950's, Project OSCAR (Orbiting Satellite Carrying Amateur Radio) was formed with the goal to put amateur radio equipment into earth orbit
- OSCAR-1 was launched in 1961 – first amateur satellite in space
- AMSAT was formed in 1969 in Washington, D.C. to take the amateur satellite effort worldwide
- The Amateur Satellite Service was created in 1971 when spectrum for amateur satellites was allocated by the WARC
- The IARU established the Satellite Advisory Panel to manage frequency coordination in the Amateur Satellite Service
- In the past 45 years 58 OSCAR satellites have been launched and activated (including 4 Cubesats), though there is no requirement for amateur satellites to be designated as OSCARS
- AMSAT organizations exist worldwide and support building and builders of amateur satellites

Chuck Towns K6LFH in his garage with OSCAR-II

Personal Satellite & Cubesat Experience

- Licensed in February 2003 and became interested in satellites in March 2003 – first contact on UO-14
- First interest in Cubesats when CanX-1 was launched and then lost
- Used radios, scanners, spectrum analyzer and strip chart to search for signals from CanX-1 and DTUsat. Copied TLM from Quakesat and CW from Cute 1 and XI-IV
- CanX-1 was never heard but the experience of tracking Cubesats was valuable



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Are Amateur Satellite Operations Ham Radio or Real Science – or Both?

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Amateur Satellites = Real Science

OSCAR 5	1970	First use of passive magnetic stabilization
OSCAR 6	1972	Codestore (CW Store and Forward) Message System), First Use of CMOS Chips
OSCAR 7	1974	Battery Charge Regulator, Store and Forward, First Emergency Beacon Locator Demo
OSCAR 11	1984	Imaging, Dust Impact Detectors, Geiger Counters, Digital Communications
OSCAR 14	1990	Packet Radio, 9.6K Data Rate, Imaging, Digital Store and Forwarding
OSCAR 23	1992	Wide and Narrow Imaging, Cosmic Ray detection, radiation dose monitor
OSCAR 24	1993	2.4GHz S-Band Transponder
OSCAR 25	1993	Imaging, IR Sensor Experiment
OSCAR 28	1993	38k4 Digital Link, GPS Experiment, Star Sensor, Cosmic Ray Detection, DSP
OSCAR 34	1998	Direct Sequence Spread Spectrum
OSCAR 36	1999	1MB/Sec Digital, Viterbi encoding
OSCAR 38	2000	First Automatic Launcher (6 Picosatellites)
OSCAR 39	2000	Space Plasma Experiment
OSCAR 43	2001	Solar Cell and Mirror Experiment
OSCAR 45	2001	Tunneling Horizon Detector (JPL/Stanford), Digital Camera
OSCAR 51	2004	Simultaneous Voice and High Speed Data
OSCAR 53	2005	Cold Gas Attitude thrusters, High Resolution Color Imaging, Cubesat Launcher

Why Hams Complain about Cubesats…

- Postings on the AMSAT-BB do complain about Cubesats not being “true” amateur satellites (this is, of course. false)
- Cubesats are not exciting to the average ham because they are generally misunderstood and/or under promoted
- Hams see themselves as stakeholders who want to see spectrum used for **voice** communications
- Most ham Cubesat experience is with CW beacons, which are not as attractive in a world where Morse code skills are no longer required (bleepsat syndrome)

Personal Observations

- Quakesat's dubious non-commercial mission left radio amateurs with a suspicious attitude ("QuakeFinder is a private company…")
- Information about individual Cubesat projects seems difficult to come by – many project websites are not kept up to date or don't exist at all and amateur radio operators don't find the information they need
- Most radio amateurs don't appreciate what data Cubesats are producing because not all project teams publicize experiments and experiment results
- Cubesat TLM and mission data is generally only transmitted over control stations so radio amateurs worldwide don't get to see it

What Benefits Come from Amateur Radio?

- **There are many…**
  - Amateur Satellite frequencies are available and coordinated for use by non-commercial payloads including Cubesats (for free!)
  - Amateur Satellite groundstation equipment is affordable, commercial off-the-shelf (COTS)
  - AMSAT members will volunteer as advisors particularly to help with groundstation construction configuration and peer reviews
  - Amateur satellite operators worldwide are available to collect telemetry and assist with other signal reporting

Amateur Radio Reports of Cute 1.7

Amateur Radio Use Tradeoffs

- **Spectrum**
  - 2M is available, but under attack from poachers worldwide
  - 70cm is secondary, but so far no real problems arise in most (but not all) IARU Regions
  - 2.4G spectrum is available, is secondary, doppler shift is great and the link margin may be undesirable if the power budget is low
- **Emissions**
  - The majority of hams are equipped for FM only – and of those, digital modes are generally popular only with APRS users
  - Digitally capable stations are stuck in 1200 baud mode – hams like to hear what they are “hearing”
  - Single Sideband of any sort creates excitement and support, but the number of hams that are SSB capable is lower

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Where does AMSAT Fit with Cubesats?

- AMSAT has many members involved with Cubesat programs at many universities and colleges
- AMSAT can match members and principal scientists up with Cubesat programs to provide mentoring and help with spacecraft and systems design and peer reviews
- AMSAT will work with you and the IARU to insure your Cubesat program receives frequency coordination
- AMSAT can help bridge communications between Cubesat programs and radio amateurs by helping to promote your Cubesat mission
- AMSAT will work with you to educate the amateur radio community about your project and to educate you about the amateur radio community

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AMSAT School Outreach

- **AMSAT is partnered with NASA and the ARRL to support the very successful ARISS program**
- **Through ARISS, AMSAT members provide in-school support during school contacts with the ISS**
- **In the past, AMSAT has not vigorously promoted Cubesats in K-12 schools and colleges**
  - Formal training material about Cubesat missions generally not available to AMSAT members
  - No training materials available for members and Area Coordinators to distribute to schools
  - Difficult to find information on the Internet – no major central repository of information in traditional places hams visit
- **AMSAT has appointed Dr. Paul Shuch as Director of Education to improve outreach and educational materials**

So what can Cubesat project teams do to promote interest in the amateur radio community?

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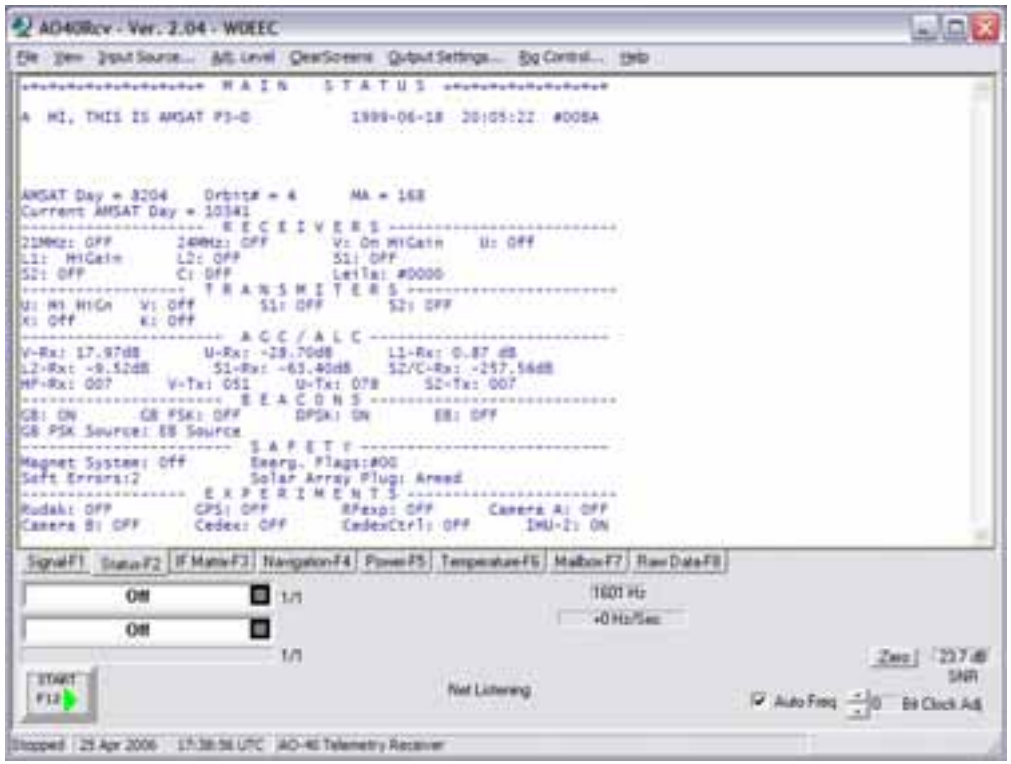
Hams will Become Excited if…

- The Cubesat experience provides hams with a hands-on experience
- Beacon telemetry is 1200 baud or soundcard software is provided (AO-40 - 400bps PSK)
- Payload TLM data is transmitted periodically, not just when over control stations
- APRS digipeaters and other packet BBS experiments
- SSTV and/or other digital modes are used



Provide More Information to Hams

- In the past Cubesat information was scattered and little was communicated directly to AMSAT members about experiments and telemetry content
- Hams generally haven't been familiar with Cubesat missions until after launch – teams should be more proactive about pre-launch news and mission reports (the SSETI Express team did it right!)
- The AMSAT website is now database driven and can support as much information about your project as you are willing to provide
- Cubesat projects have project pages on AMSAT.org, though currently there is little information provided by project teams
- AMSAT News Service/RSS feeds will distribute your project updates during construction, launch and deployment if you provide them

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Help AMSAT Get Schools Involved

- Space is very popular among students, even in the K-8 segment
- Provide school oriented materials about Cubesat Projects to AMSAT Area Coordinators to help interest students in space programs
- Voice robots/digital voice TLM experiments will help AMSAT stimulate student interest
- Provide materials (and project team participation) at AMSAT "Space Days"

Promotion, promotion, promotion…

- SuitSat was a public relations bonanza – so much so the AMSAT website was almost non-operational
- AMSAT can work with you to host launch video feeds and other multimedia web experiences
- The more people know, the more they will be excited

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Attend the 2006 AMSAT Space Symposium

- The 2006 Symposium will be held at the Crowne Plaza hotel in Foster City, CA on October 6-8 2006
- Friday, Saturday and Sunday presentations and demonstrations
- Cubesat projects are invited to present and network with the AMSAT leadership team
- Breakout rooms will be available
- Awards Banquet with keynote speaker on Saturday Evening
- Sponsored by Project OSCAR

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Join AMSAT!

- AMSAT membership starts at $44 per year
- School/Club memberships are available
- Membership includes subscription to the AMSAT Journal and discounts on publications, software and apparel
- Your membership helps to support the amateur satellite effort in North America

Thank you!

Questions and Answers…