National Science Foundation CubeSat Workshop

- Frequency Coordination Update -

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AMSAT-NA

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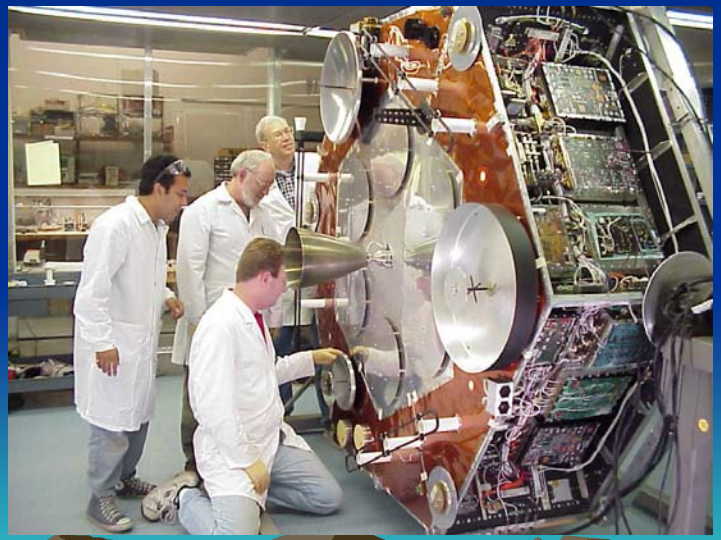
Satellites Completing Frequency Coordination Since Start of Process in 2003

- Total of **99** Spacecraft Coordinated
  - Satellites Specifically Intended for General Amateur Community Utilization: **9**
  - Satellites Intended for University Use with Some Amateur Community Utilization: **90**
  - Satellites Coordinated in the Past 11 Months: **31**

We Build, Launch And Operate Satellites

AMSAT

And Coordinate Spectrum Too!



Satellites Currently In Coordination Process

- Total of **11** Satellites Currently In Frequency Coordination*

* As of December 6, 2009

Satellite Coordination Processing Time
- During Past 12 Months -

- Minimum Processing Time: 10 days
- Maximum Processing Time: 10 months
- Average Processing Time: ≈ 2 months

[NOTE: 10 months is BRIEF Compared With FCC Processing Time. FCC or NTIA Processing is Compulsory for All Other Space System Applications]

Reasons for Longer Processing Times

- Peak Volunteer Workload (There are now about 7 people involved, meeting once per 2 weeks via SKYPE)
- Applicant Response Times to IARU Coordinator Questions are Sometimes Slow
- Missing Key Information on Application:
  - Applicants Don't Always Read the Filing Information and Don't Understand the ITU and IARU Processes.
  - Applicants Do Not Realize the Importance Place on the Ability of the Satellite to Terminate its Transmissions – HARD ITU Requirement.
  - Applicants Do Not Realize the Requirement for ITU "Advanced Notice" Procedure in Most Countries. [NOTE: FCC still ignoring this issue.]

Common Issues With IARU Frequency Request Form Submissions

- You must show “the world” (via the IARU Coordinator) that you have positive control of your transmitter at all times and with reasonable response times.
- You must differentiate between signals generated within you system for TC and TM and other emission sources.

[NOTE: This amounts to knowing the difference between Sections 4 c/d and Sections 5a and 6a of our form.]

You must determine if your satellite requires ITU Advanced Notice by your Frequency Regulatory Administration.

[NOTE: The FCC is currently ignoring this requirement for amateur satellites.]

Applying for Frequency Coordination

- Your Project Must:
  - Comply with Rules of the Amateur Satellite Service
  - Include a Properly Licensed Radio Amateur Who Will Operate the Satellite Control Station (In U.S., he/she must be a volunteer (i.e. Unpaid Staff Member).
- Ready to Apply?
  - Click on www.iaru.org
  - Click on “Satellite Service”
  - Click on “Frequency Coordination”
  - Submit Application Form to: IARU Satellite Advisor at satcoord@iaru.org

Some Feedback from the Amateur Radio Community

- Based on Listening to Several Cubesats -

- Using the SAME FREQUENCY for Uplink and Downlink is still viewed as a bad idea based on the ability to control the spacecraft under non-nominal conditions. -THINK POSITIVE CONTROL.
- Cubesat data formats generally have lots of gaps in transmission to save power. This is understood but, this makes the problems of tracking/tuning/decoding data very hard for any ground station (amateur and university alike).
- From the amateur radio perspective the most successful cubesats have been the Japanese spacecraft using 80 mW continuous transmission systems. These can be received well with a good pre-amp and a 12 element crossed Yagi beam antenna.

Some Feedback from the Amateur Radio Community
- The Tale of Two Texan Cubsats -

- In Terms of Working With the IARU Frequency Coordinators
  - GOOD: BIVO-1, Univ. of Texas at Austin
    - Coordinated in 1 month
    - Responsive Team
    - No Worries
    - Operating within 437.4 MHz range
  - BAD: AggieSat- Texas A&M
    - Did not make IARU Filing
    - Used Frequency in Transponder Downlink Portion of UHF Band (436.25 MHz)
    - Did Not Publish Telemetry Standards or Decoding Information
    - We do not know if ground station is operated by a licensed radio amateur

Some Important Issues (1):

- When is it Appropriate for a Government funded project to use the Amateur Radio Service for Operations of it's Missions (regardless of satellite size)?

ANSWER: It is AMSAT/IARU interpretation of FCC and ITU Radio Regulations that it is never appropriate, unless the government mission carries an amateur "*space station*" (as a component) intended solely for use by radio amateurs and licensed by the FCC. Government use of the radio spectrum is NOT controlled by the FCC but, by the NTIA.

Some Important Issues (1A):

- Radio Spectrum for Government Programs is a Resource to be Provided by the Authorizing Agency:
  - Satisfying OMB Circular A-11:
    OMB Circular No. A-11 states in Section 34.1: "You must obtain a certification by the National Telecommunications and Information Administration, Department of Commerce that the radio frequency required is available before you submit estimates for the development or procurement of major communications-electronics systems (including all systems employing space satellite techniques)".

Some Important Issues (1B):

- Specific Issues and No-Nos for Amateur Satellite Licensees:
  - Satellite Operators (at least, U.S. licensees) cannot have a “pecuniary interest” (i.e., be paid)
  - Satellite cannot be a part of a commercial development process
  - Satellite system cannot encrypt or obscure data transmissions (except for telecommands). Data formats must be open and made available (and should be published prior to launch).
  - Specifically, scientific data which is intended to be proprietary to the scientists involved should not be transmitted in the amateur satellite service.
  - Transmissions must be intended for the training/education of individual radio amateurs in the “Radio Arts and Sciences.”

Some Important Issues (1C):

- In Summary On This Last Point:
  - Amateur Satellite Service Can Be Used For:
    - Scientific Satellites? **- NO** – Use Space Research Service or Other Space Service
    - Educational Satellites? - **YES**, If Compliant with ITU Regulations.

Some Important Issues (2):

- FCC Orbit Debris Report & Order:
  - FCC Issued R&O Requiring All Space Services to Submit Orbit Debris Mitigation Plan as Part of all Applications.
  - AMSAT-NA Filed a Petition for Reconsideration Stating FCC Had No Authority to Act on Orbit Debris Under Federal Law.
  - AMSAT-NA and FCC Met to Discuss in May 2005 and lost on this issue.
  - FCC Requested that Future Amateur Satellites (and Particularly University Satellites) NOT Use Orbits in the Range 600 km to 2000 km Altitude

Some Important Issues(2):

- FCC Has Prevailed On The Orbit Debris Issue:
  - Current Situation is Uncertain as to what University Projects should do about this thus, compliance with the < 600 km altitude rule is advised.
  - AMSAT Needs University Organization(s) to Become Politically Active on the Orbit Debris Issue and Many Other Regulatory Matters Which Are In Their Own Interest.
  - AMSAT-NA Invites University Organization(s) to Actively Work With Us to Prepare Arguments Supporting Our Orbit Occupation and Radio Emission Interests.
  - POC: Dr. Perry I. Klein

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Some Important Issues (3):

- Professionally, I am a Satellite Systems and Satellite Telecommunications Engineer
- In my Avocation I Design and Build Small Telecommunications Satellites for the Use of Fellow Radio Amateurs and Educators.
- For Both: I spend 5-10% of my time Using and Learning More About International Satellite Radio Regulations. - I have to!
- SO, WHY DON'T YOU ? It's a tax you must pay!

This Time Let Me Try The SHAME TECHNIQUE

- Did you ever stop to consider:
  - Why is it that so many “Radio Hams” know the International Radio Regulations and Why so Few Educators Do?
  - Isn’t it Time to Change This?
  - Maybe the Radio Spectrum is More Important Than You Thought it was.

Summary

- AMSAT/IARU Frequency Coordination Process Is Generally Working Well
- Universities Need to Become More Politically Active and Involved in Frequency Matters. It's a Responsibility!
- We Need Help With the Paperwork