



CubeSat High-Speed Downlink Communications Update

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CHDC Goals



- Maximize downlink bandwidth and contact time for science missions
- Lower cost and regulatory burden on PIs
- Establish open knowledge base of NSF-specific CHDC solutions



CHDC Description

- Provide high-speed data downlinks for future CubeSat NSF missions
 - Expandable to all educational missions in the future
- Open standards/interoperable
- Multiple Access
- Meetings:
 - Proposed at CEDAR 2009 by Chuck Swenson
 - Discussed at SmallSat 2009
 - AGU meeting in December 2009 and 2010
- <http://groups.google.com/group/cubesat-high-speed-downlink>
- http://mstl.atl.calpoly.edu/~bklofas/NSF_comm/

Outcome of last meeting



- Met at AGU last December
- John Malsbury is conducting a survey for NSF PIs about what they want out of this committee
 - jmalsbury@sparton.com
- Sara Spangelo is collecting information about available ground stations and spacecraft modulations
 - saracs@umich.edu



Regulatory Progress

- Electromagnetic Spectrum Management group at NSF (Tom Gergely and Andy Clegg) submitted a proposal to place CubeSats on the agenda for the WRC-15.
 - 10 MHz band within 200 to 3000 MHz
 - Worldwide basis
 - Minimum regulatory burden
- Proposal was blocked by DoD, opposed by FAA, but had good support from NASA
 - Currently being improved by these organizations

Regulatory Progress (2)



- NTIA suggested placing CubeSats on the WRC-19 agenda, pending successful completion of feasibility studies
- Introduce a Study Question in ITU-R Study Group 7. Studies could eventually lead to an ITU-R Recommendation



Current Frequency Allocations

Award	Project	PIs	Type	License			Downlink Frequencies
				Agency	Sponsor	Status	
# 1	RAX	Cutler/Bahcivan	Amateur/ISM	FCC	UMich	Granted	437 MHz; 2.4 GHz ISM
	FireFly	Rowland/Weatherwax	Space Research	NTIA	NASA	Submitted	400 MHz
ARRA	FIREBIRD	Klumpar/Spence	Amateur	FCC	MSU	Coordinated	145 MHz, 19200baud GMSK
	DICE	Crowley/Swenson	Meteorological Satellite	NTIA	NSF	Not submitted	460 MHz, 1.5Mbps
# 2	CINEMA	Lin	Space Research	NTIA	NSF	Submitted	2.2 GHz
	CSSWE	Li/Palo	Amateur	FCC	U Colorado	Coordinated	437 MHz



Summary of Current Approaches

	Downlink	Spacecraft TX	Ground Station RX
RAX (STP-S26)	437 MHz 9600 baud	AstroDev Helium	Icom 910
FireFly (Elana4/CRS-2)	401 MHz	AstroDev Colony-2	
FIREBIRD	145 MHz 19200 baud	AstroDev Helium	Icom 910
DICE (Elana3/NPP)	460 MHz 1.5 Mbps	L-3 Cadet	USRP
CINEMA (Elana6/OUTSat)	2.2 GHz 1 Mbps	Emhiser EDTC-01E1A102-UBC0	11m dish
CSSWE	437 MHz 9600 baud	SX1231 (all-in-one chip)	Kenwood TS-2000



How to Help

- Comment favorably when the FCC puts out the CubeSat proposal for public comment
- Join the Google Groups
 - <http://groups.google.com/group/cubesat-high-speed-downlink>
- Monitor/participate in the work of the US Study Group 7 (Science Services)
 - <https://www.ussg7.org/>
 - Username: sg7User Password: 4webAccess

Thanks



- Thanks for your time
- bryan.klofas@sri.com

- Backup slides provided by Tom Gergely

Frequency Allocations For CubeSats: Where Does it Stand

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CubeSat Workshop

Cal Poly

April 22, 2011



Long Term Goal: Allocated or Designated Band(s) for CubeSat operations (command, control and data relay)

Conditions:

- **Sufficient bandwidth to accommodate current and future uses**
- **Minimum of International Regulatory Obligations**
- **Uplink (Command and Control) and Downlink (Data Relay) in the same band or separate uplink and downlink bands**



Roadmap

Two possible ways to approach the problem:

- Place Issue on the Agenda of a World Radiocommunication Conference (WRC-15 or WRC-19)
- Introduce a Study Question in ITU-R Study Group 7. Studies could eventually lead to an ITU-R Recommendation

These routes are NOT mutually exclusive. In fact, the first one would also require ITU-R studies, and the second could eventually lead to an Agenda Item



(Some) Difficulties

- **No definition of pico or nanosatellites in the ITU. Not a trivial issue: CubeSats need to be differentiated from other satellites, so the appropriate regulations (or lack of them) can be applied to them and ONLY to them**
- **No adequate explanation why they cannot operate in existing Space Research, Space Ops or Meteorological Satellite Bands**
- **No reliable estimate of required bandwidth (worldwide)**
- **Some would prefer domestic regulations to precede ITU action**
- **In the view of some, the issue is not mature for WRC action**
- **Not an exhaustive list!**



The Future Agenda Proposal Route

NSF proposal for a WRC-15 agenda item submitted to the Radio Conference Subcommittee (RCS) of the Interdepartment Radio Advisory Committee (IRAC) – September, 2010

- ✓ Seeks up to 10 MHz of spectrum designated for use by picosatellite and nanosatellite operations, based on studies, described in a
- ✓ Resolution, that urges (mandates) the ITU-R to conduct studies to identify up to 10 MHz of spectrum for pico and nanosatellite operations,
 - ✓ In the 200 – 3 000 MHz range
 - ✓ while protecting existing services
 - ✓ on a worldwide basis
 - ✓ with minimum regulatory requirements



Where Do We Stand?

- The NSF proposal has been repeatedly revised (and improved) based on NASA, FAA and DoD inputs
- In spite of which the RCS approved only a proposal to be submitted to WRC-19 on condition that an ITU Question be submitted to US WP 7B
- Draft proposal sent to the FCC by NTIA (Feb 23, 2011)
- FCC submits proposal to the meeting of sub working group 3 of the WRC-12 Advisory Committee (WAC) – March 3, 2011
- Proposal is strongly supported by Boeing, ARRL; but strongly opposed by Iridium, failing to reach consensus
- At present the proposal is in the NTIA/FCC reconciliation process (the prospects for it to make it are not good)



The Study Question Route

- NSF introduced a draft “Study Question in the appropriate US ITU-R Working Party (US WP 7B) at the Meeting of March 24, 2011
- Requests for Revisions (Iridium and others)
- Revised “Question” submitted to April 21 meeting.
- If approved in the US, draft study question is sent to ITU as a US contribution



How You Can Help ?

- File comments with the FCC. See:
http://www.fcc.gov/Daily_Releases/Daily_Business/2011/db0127/DA-11-156A1.pdf
- The Nanosat proposal may be found in Attachment 2 of the above public notice
- You may also write, expressing support to:
Alexander.Roytblatt@fcc.gov
- Participate in the work of US WP 7B . See:
<http://www.ussq7.org>
Username: sg7User ; Password: 4webAccess
Next meeting is May 26, 1:30 PM (see website for details)

