CubeSat High-Speed Downlink Communications (CHDC) Update

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CHDC Initiative Description

- Provide a high-speed data downlink for future NSF CubeSat Science missions
- Open standards/interoperable
- Multiple access
- Initially NSF, but expandable to CubeSat community

- Meetings
  - Proposed at CEDAR 2009 by Chuck Swenson
  - Discussed at SmallSat 2009
  - Meeting at AGU in San Francisco Dec 2009, sponsored by NSF

- http://groups.google.com/group/cubesat-high-speed-downlink
- http://mstl.atl.calpoly.edu/~bklofas/NSF_comm/

CHDC Subcommittees

- Regulatory – Dr. Andy Clegg (NSF)
  - Explore available frequencies
  - Define NSF/NTIA authorization process
- Modulation/Protocols – John Malsbury (Engiflex)
  - Investigate modulation schemes & COMM protocol
- Hardware – ?
  - Space segment
  - Ground stations
  - Network

Current Communications

- In general, most current CubeSats use Amateur Radio frequencies
- Current NSF CubeSats use of Amateur Radio frequencies is not sustainable
  - Legal issues with Government-funded CubeSats using amateur frequencies
  - Bandwidth (kHz) too limited for good Science
  - Conflict with other satellites using same frequencies
  - Community outreach to RF amateurs on behalf of NSF CubeSats has been lacking

Paths Forward

Award	Project	PIs	License Type	License Agency	Sponsor	Frequencies
#1	RAX	Cutler/Bahcivan	Amateur/ISM	FCC	UMich	437 MHz, 2.4 GHz
	FireFly	Rowland/Weatherwax	ISM	NTIA	NASA	2.4 GHz
Stimulus	FIREBIRD	Klumpar/Spence	Amateur	FCC	MSU	437 ?
	DICE	Crowley/Swenson	Experimental ?	NTIA	NSF	460 MHz
#2	CINEMA	Lin	Space Research	NTIA	NASA	2.2 GHz
	CSSWE	Li/Palo	Amateur	FCC	U Colorado	UHF ?

- Possible future ways forward
  - NTIA license
  - FCC license
  - Amending frequency allocation

US Govt Frequency Authorizations for Cubesats

- NSF CubeSats may be eligible for licensing by NTIA rather than FCC
- Authorization via Spectrum Management Office of NSF or other Government partner
- May not be faster than going through FCC
- Spectrum management personnel can work with you during the process

Authorization Process

1. Prepare NTIA Certification Application by assembling “Redbook” technical data for desired space-based (SB) & ground-based (GB) elements (TX, RX, and antenna)
   - Several Weeks
2. NSF* submits application to NTIA for stage 2 (experimental certification) for SB and stage 4 (operational certification) for GB elements
   - > 6 Months to obtain certification**
3. Prepare Frequency Authorization Proposal for authorization to transmit at specific frequencies
   - ~1 Week
4. NSF* submits Frequency Authorization Proposal to NTIA
   - > 1 Month to obtain authorization

* or NASA, DoD, or other US Government Sponsor

** Not authorization to transmit

What are the Rules?

- The rules for spectrum certification are in the NTIA "Redbook" Manual:

http://www.ntia.doc.gov/osmhome/redbook/redbook.html

- Step 1 (spectrum certification), technical data needed is described in section 10.8.

- SB element experimental stage and GB operational stage described in section 10.4.

Where to Start?

- Upon selection by NSF, contact the NSF spectrum management office
- Discuss with NSF a suitable band of operation, if you haven't chosen one already (or even if you have)
- Look at the required certification data and get your radio manufacturer to supply the appropriate data
- Start the process one year or more before launch
- NSF contact:
  - Dr. Andrew Clegg, aclegg@nsf.gov, 703-292-4892

Thanks!

- Trying to organize a meeting at SmallSat this year for this effort
- Contact me if interested

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- Backup Slides – Original slides from Andy Clegg at NSF

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Steps to Getting Federal Government Frequency Authorization for CubeSats

- CubeSats funded by the Federal government may be eligible for licensing by NTIA rather than FCC
- This is accomplished by working through the spectrum management office of the funding agency
- This is not necessarily faster than going through the FCC, but probably a bit easier since the spectrum management personnel can work with you during the process
- Getting an NTIA license (actually referred to as an “authorization”) is a two-step process, which is described in the following slides

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Step 1: Spectrum Certification

- Your radio system must obtain certification that it meets various technical criteria, such as out-of-band emissions limits, antenna performance standards, etc.
- Certification is obtained through your sponsoring agency by submitting an electronic application to the Spectrum Planning Subcommittee (SPS) of NTIA's Interdepartment Radio Advisory Committee (IRAC)
- You will need to supply all of the relevant technical data for the application
- Both your space-based radio AND your ground station(s) must be certified
- Certification is not authorization to transmit

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Step 2: Frequency Authorization

- After spectrum certification is obtained, you must apply for an NTIA authorization to transmit on one or more specific frequencies.
- This is accomplished through your sponsoring agency by submitting a proposal to the Frequency Assignment Subcommittee (FAS) of the IRAC

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Where are the Rules?

- The rules for spectrum certification are in the NTIA Manual.
- The manual is available at http://www.ntia.doc.gov/osmhome/redbook/redbook.html
- For step 1 (spectrum certification), the particular technical data that you will need to supply are described in section 10.8.
- Note that there are various stages of certification, ranging from conceptual to operational. These are described in section 10.4. Your space radio must be certified for Stage 2 (experimental), and your ground station(s) must be certified for Stage 4 (operational).

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Where are the Rules? (cont'd)

- The rules for frequency authorization are in chapter 9
- You don't need to know all the details – your sponsoring agency will prepare the authorization request
- There are certain technical details that will be required, but generally that information will have been prepared for the certification process

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Considerations

- Your sponsoring agency may or may not agree to license your CubeSat project through NTIA
- NSF is willing to go this route for NSF-funded CubeSats unless there are extenuating circumstances that make this difficult or impossible
- This is a LONG LEAD-TIME process
  - Preparation of the certification application can take many weeks. It requires detailed technical characterization of your radio and antenna systems.
  - Once the application is submitted, certification can take 6 months or more, especially for space-based transmitters.
  - Preparation of a frequency authorization proposal is generally fairly quick – a week or so if all the data are known
  - Obtaining frequency authorization is a minimum of one month once the application is submitted. It can take longer, especially if there are objections/concerns

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Where to Start?

- Contact your sponsoring agency's spectrum management office and determine if they are willing to support an NTIA authorization
- Discuss with your agency a suitable band of operation, if you haven't chosen one already (or even if you have)
- Look at the required certification data and get your radio manufacturer to supply the appropriate data
- Start the process one year or more before launch
- NSF contact:
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