SMALLSAT FREQUENCY ISSUES AND CHOICES

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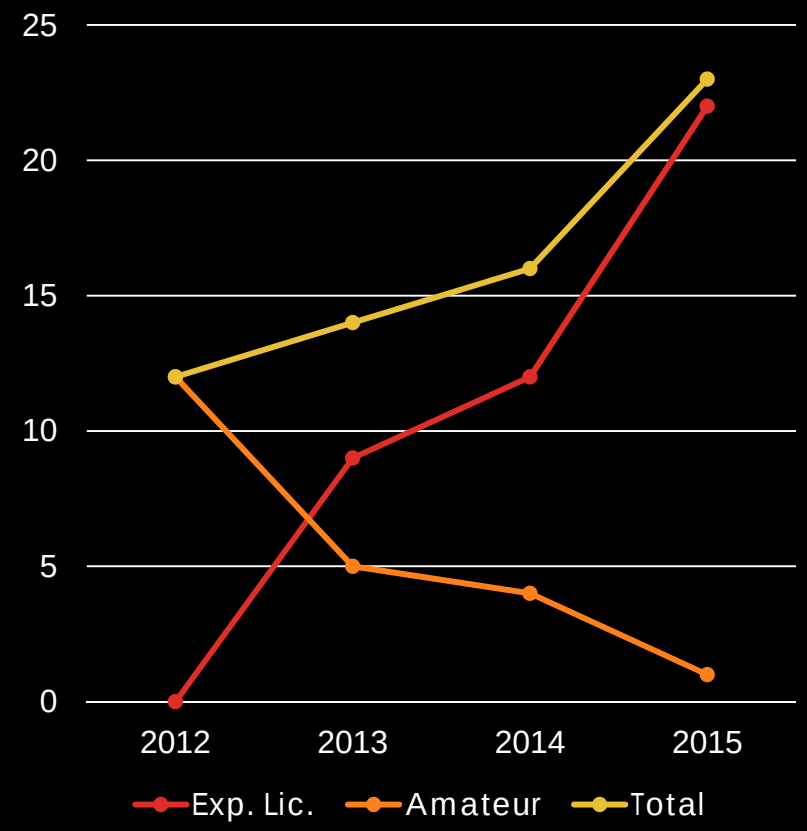
GROWTH OF SMALLSAT EXPERIMENTAL LICENSES

Year	Exper. Licenses	Amateur Licenses
2012	0	12
2013	9	5
2014	12	4
2015 (first 6 mo.)	22	1
Total	43	22



FREQUENCY BANDS USED

Frequency Band (MHz)	Region 1	Region 2	Region 3
144-146	AMATEUR AMATEUR-SAT	AMATEUR AMATEUR-SAT	AMATEUR AMATEUR-SAT
400.15-401	METEOROLOGICAL AIDS METEOROLOGICAL-SAT (s-E) MOBILE-SAT (s-E) SPACE RESEARCH (s-E) Space Operation (s-E)	METEOROLOGICAL AIDS METEOROLOGICAL-SAT (s-E) MOBILE-SAT (s-E) SPACE RESEARCH (s-E) Space Operation (s-E)	METEOROLOGICAL AIDS METEOROLOGICAL-SAT (s-E) MOBILE-SAT (s-E) SPACE RESEARCH (s-E) Space Operation (s-E)
401-402	METEOROLOGICAL AIDS SPACE OPERATION (s-E) EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile	METEOROLOGICAL AIDS SPACE OPERATION (s-E) EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile	METEOROLOGICAL AIDS SPACE OPERATION (s-E) EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile
402-403	METEOROLOGICAL AIDS EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile	METEOROLOGICAL AIDS EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile	METEOROLOGICAL AIDS EARTH EXPLORATION-SAT (E-s) METEOROLOGICAL-SAT (E-s) Fixed, Mobile
435-438	AMATEUR RADIOLOCATION Earth Exploration-Sat (active)	RADIOLOCATION Amateur Earth Exploration-Sat (active)	RADIOLOCATION Amateur Earth Exploration-Sat (active)

FREQUENCY BANDS USED

Frequency Band (MHz)	Region 1	Region 2	Region 3
450-454	FIXED MOBILE	FIXED MOBILE	FIXED MOBILE
902-928	FIXED MOBILE BROADCASTING Radiolocation	FIXED Amateur Mobile Radiolocation	FIXED MOBILE BROADCASTING Radiolocation
1613.8-1626.5	MOBILE-SAT (E-s) AERONAUTICAL RADIONAVIGATION Mobile-sat (s-E)	MOBILE-SAT (E-s) AERONAUTICAL RADIONAVIGATION RADIODETERMINATION-SAT (E-s) Mobile-sat (s-E)	MOBILE-SAT (E-s) AERONAUTICAL RADIONAVIGATION Radiodetermination-Sat (E-s) Mobile-sat (s-E)
2020-2025	FIXED MOBILE	FIXED MOBILE MOBILE-SAT (E-s)	FIXED MOBILE
2025-2110	SPACE OPERATION (E-s) (s-s) EARTH EXPLORATION-SAT (E-s) (s-s) FIXED MOBILE SPACE RESEARCH (E-s) (s-s)	SPACE OPERATION (E-s) (s-s) EARTH EXPLORATION-SAT (E-s) (s-s) FIXED MOBILE SPACE RESEARCH (E-s) (s-s)	SPACE OPERATION (E-s) (s-s) EARTH EXPLORATION-SAT (E-s) (s-s) FIXED MOBILE SPACE RESEARCH (E-s) (s-s)

NOTE: The 902-928 MHz(in Region 2) and 2400-2483.5 MHz bands are also designated as ISM bands.

FREQUENCY BANDS USED

Frequency Band (MHz)	Region 1	Region 2	Region 3
2400-2450	FIXED MOBILE Amateur Radiolocation	FIXED MOBILE RADIOLOCATION Amateur	FIXED MOBILE RADIOLOCATION Amateur
2450-2483.5	FIXED MOBILE Radiolocation	FIXED MOBILE RADIOLOCATION	FIXED MOBILE RADIOLOCATION
8025-8175	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE
8175-8215	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) METEOROLOGICAL-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) METEOROLOGICAL-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) METEOROLOGICAL-SAT (E-s) MOBILE
8215-8400	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE	EARTH EXPLORATION-SAT (s-E) FIXED FIXED-SAT (E-s) MOBILE
8450-8500	FIXED MOBILE SPACE RESEARCH (s-E)	FIXED MOBILE SPACE RESEARCH (s-E)	FIXED MOBILE SPACE RESEARCH (s-E)

FREQUENCY BANDS USED

- The United States has developed its own Table of Frequency Allocations (47 CFR §2.106).
  - The U.S. Table may not be the same as the International Table of Frequency Allocations in a particular frequency band.
- Divided between Federal Government Users and Non-Federal Government Users
  - Certain Bands are limited to Federal Government use
  - Coordination for Non-Federal use of these bands may be difficult.

FCC LICENSING

- Start early, at least 6 months before launch. The licensing process can be lengthy depending on the frequencies chosen
- If FCC licensing is appropriate, there are three possible licensing regimes:
  - Experimental Licensing through Part 5
  - Regular Satellite Licensing through Part 25
  - Amateur Radio for communication by amateurs for permitted amateur radio purposes under Part 97
- Regime chosen depends on the purpose of the satellite.
- International coordination and notification requirements exist no matter what regime is chosen. Coordination can be time consuming.

EXPERIMENTAL OPERATIONS

- Regulated under Part 5 of the FCC rules
- Stations operating in the Experimental Radio Service:
  - May conduct the following types of operations:
    - Experimentation in scientific or technical radio research
    - Communications essential to a research project
  - Are authorized on a non-interference, non-protected basis (NIB)
  - Can be in any frequency band, but use of appropriately allocated bands may make NIB operations easier.
- The regular license period for stations in the Experimental Radio Service is either 2 or 5 years.
- Experimental licenses are administered by the FCC's Office of Engineering and Technology
- FCC/OET coordinates satellite applications with the FCC's International Bureau.

EXPERIMENTAL LICENSING REQUIRED INFORMATION

- Information listed as required for the application in Part 5 of the Commission's Rules
- SpaceCap file (for ITU submission)
- Orbital Debris and Assessment Report (ODAR)

- All of the above information is required, no exceptions. Failure to provide the required information will lead to delays in processing.

PART 25 OPERATIONS

- Regulated under Part 25 of the FCC rules
- Administered by the FCC's International Bureau
- Primarily used for commercial services
- Requires a detailed legal and technical submission
- ITU SpaceCap file is required in addition to the FCC application

USING AMATEUR FREQUENCIES FOR SMALLSATS

- Amateur satellite frequency bands may be used for smallsats provided that the communication is by amateurs for permitted amateur radio purposes and the operations is consistent with the definitions (See 47 CFR §2.1) of the Amateur and the Amateur-Satellite Services:
  - Amateur Service: A radiocommunication service for the purpose of self-training, intercommunication and technical investigation carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and **without pecuniary** interest.
  - Amateur-Satellite Service: A radiocommunication service using space stations on earth satellites for the same purposes as those of the Amateur Service.
- Coordination with the International Amateur Radio Union (IARU) is required. Successful coordination will result in a letter from the IARU agreeing to the proposal.
- Notification to the FCC under 47 CFR Part 97 are necessary, as well.

FCC NOTIFICATION PROCESS

- An applicant must file a notification of the intention to operate on amateur radio frequencies with the FCC as set forth in Section 97.207(g) of the Commission's rules.
- The first of these notifications is a pre-space notification, made within 30 days after the date of launch vehicle determination, but no later than 90 days before integration of the satellite into the launch vehicle.

FCC NOTICE REQUIRED INFORMATION

- The following information is required:
  - IARU coordination letter
  - Detailed technical description of the design and operation of the space station
  - SpaceCap file (for ITU submission)
  - Orbital Debris and Assessment Report (ODAR)
- The notice is reviewed by the FCC for acceptability and completeness.

- All of the above information is required, no exceptions. Failure to provide the required information will lead to delays in processing.

ITU COORDINATION REQUIREMENTS

- Satellite downlink and uplink signals have the potential to interfere with radio services of other countries; therefore, coordination of frequency usage is required.
- The coordination procedure is set by treaty. Developed by the World Radio Conferences (WRC), the International Telecommunication Union (ITU) Radio Regulations contain the procedures for effecting coordination, the Radio Regulations.
- The coordination timelines are set by the ITU Radio Regulations, and are outside of the FCC's direct control.
- The next WRC begins Nov 2. Smallsat coordination issues are to be discussed.

SUMMARY

- Start the licensing process early by talking to the FCC about the mission, the contractual arrangements between the government and private entity and the frequency bands.
- Remember that the international frequency coordination process is required for all satellites and may take longer than expected.
- The IARU is increasingly reluctant to agree to operations in amateur band for non-amateur uses, and has rejected a few requests to date. Operators of smallsats should consider using bands allocated to the services that are most appropriate for their satellite's purpose.
- Don't forget about orbital debris.

CONCLUSION

- Further details of the FCC licensing process for smallsats my be obtained by reading the FCC's Public Notice "Guidance on Obtaining Licenses for Small Satellites" (DA 13-445), dated March 15, 2013.
- Detailed questions may be directed to:
  - Joseph Hill (joseph.hill@fcc.gov) for Amateur and Part 25 authorizations
  - Walter Johnston (walter.Johnston@fcc.gov) for experimental authorizations