

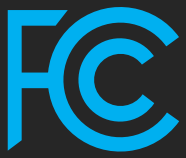
U.S. Small Satellite Licensing and the Federal Communications Commission

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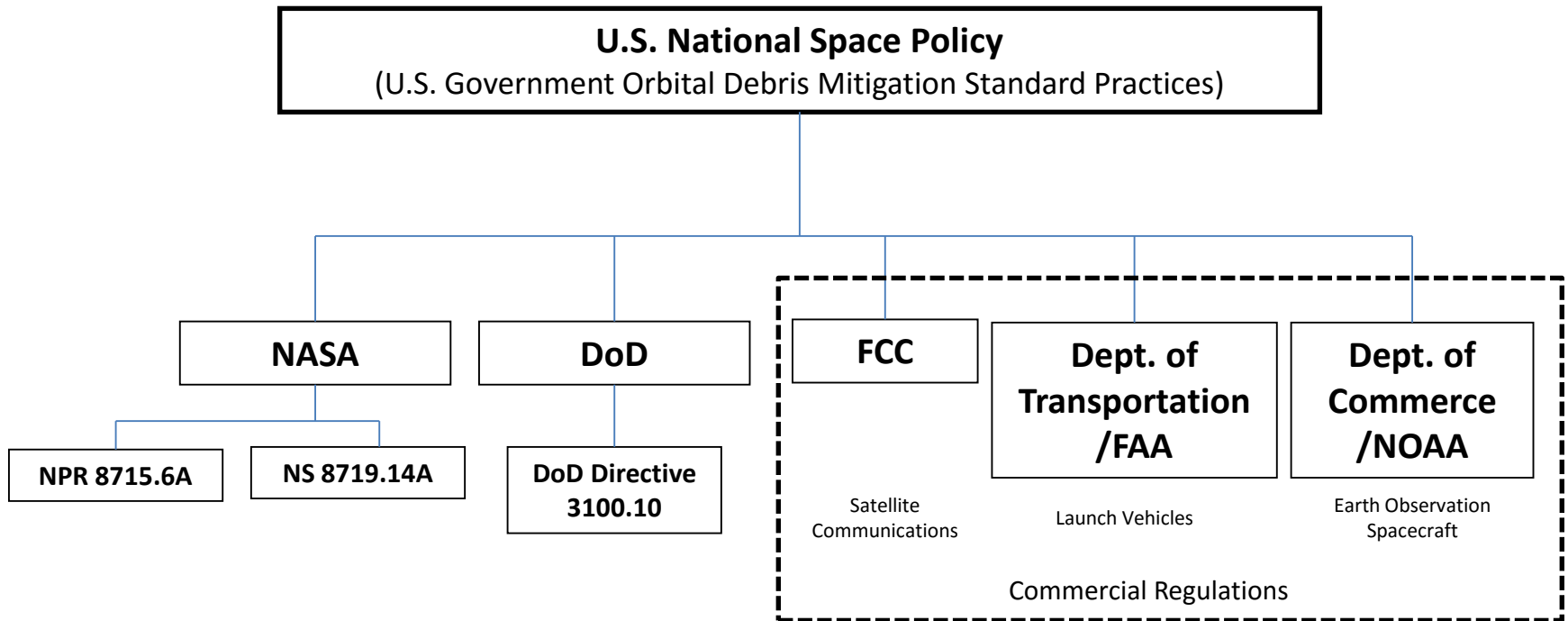
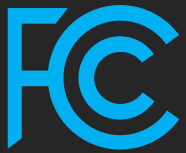
- U.S. National Legislation/ U.S. Agency Roles and Responsibilities
- FCC Licensing Processes and Approaches for Small Satellites
- Market Developments
 - Large constellations
 - Small satellites/Cubesats
- Initiatives
 - Rule making activities
 - Licensing practices

Federal/Non-Federal

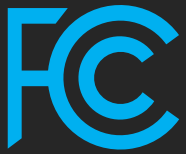


- The National Telecommunication and Information Administration authorizes frequency assignments for Federal government stations, such as satellites operated by NASA (for example, TDRSS) and the Department of Defense (for example, GPS).
- The FCC licenses commercial and private satellites (“non-Federal” satellites).
- The U.S. domestic Table of Frequency Allocations includes different columns for Federal and non-Federal stations.

Debris Mitigation—U.S.

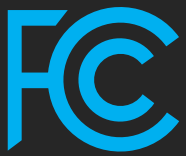


UN Registration



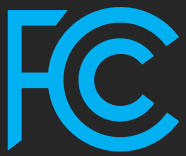
- UN registration for U.S. space objects administered by the State Department
- FCC space station licensing normally provides a basis for registration of the space object by the U.S.

Reports to Congress



- The 2015 U.S. Commercial Space Launch Competitiveness Act required an independent assessment of the framework for space traffic management and orbital debris mitigation. The assessment is to include an assessment of current activities and responsibilities, and of the risks from small satellites.
- Report Due: November 25, 2016.

FCC Licensing



- There are no special FCC rules for small satellites, but some licensing practices have been adjusted to take into account small satellites
- The FCC has three different processes for licensing, depending on the type of satellite operations:
 - Regular (“Part 25”)
 - Experimental
 - Amateur
- Common features of all three processes:
 - Orbital Debris Mitigation Plan Required
 - ITU Filing

FCC Licensing--Regular



- Primarily used for commercial services
 - Geostationary satellites (GSO)—First come/first served
 - Non-geostationary satellite (NGSO) constellation—”processing rounds”
- Requires a detailed technical and legal submission
- 15 Year license term
- Application Fee
 - GSO: \$ 130,000 /satellite (approx.)
 - NGSO: \$ 450,000 /constellation (approx.)
- Applicant must prepare an ITU filing and commit to pay ITU cost recovery fees
- There are also Market Access procedures (no fees) for technical and legal review of non-U.S. licensed satellites that will communicate with U.S. earth stations

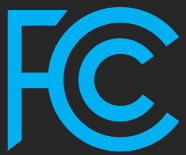
- Experimental licenses are for:
 - Experimentation in scientific or technical radio research
 - Communications essential to a research project
 - Must be compatible with other operations (licensed subject to a non-interference, no protection condition)
 - Applications in any frequency can be considered, but operations consistent with ITU allocations are encouraged to facilitate compatible operations
- 2-5 year license term
- Application filing fee \$65
- Applicant must submit the appropriate ITU filing (API or Coordination Request) file and commit to pay ITU cost recovery fees

FCC Licensing--Amateur



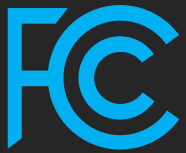
- FCC regulations permit amateur satellite operations in frequency bands allocated for amateur use, and under the control of a person holding an amateur station license
- The communication must be by amateurs for permitted amateur radio purposes (self-training, intercommunication and technical investigation carried out by amateurs, that is, duly authorized person interested in radio technique solely with a personal aim and without pecuniary interest)
- There are no application fees
- The FCC requires:
 - A letter documenting coordination with the IARU
 - ITU filing
 - Orbital debris mitigation plan

Orbital Debris Rules



- FCC adopted mandatory debris mitigation regulations in 2004.
- A debris mitigation plan must address measures to limit operational debris, collision risk, for both small and large objects, measures to avoid accidental explosions both during and after mission completion, and end-of-life disposal, including the “25 year” limit.
- If a plan is inadequate, the FCC may require modification of the plan prior to licensing, impose conditions, or deny the license.

Market Developments



- The number of satellite's launched with an FCC license has increased substantially, mainly due to cubesat missions, particularly since 2012:

2005-2011: approximately 10 or fewer FCC-licensed small satellites launched per year

2012-2015: 40 or more FCC-licensed small satellites launched per year (more than 80 in 2014!)

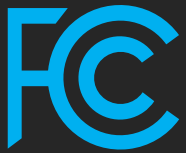
--first regular license to Planet Labs in 2014

--2016 year-to-date: 51 small satellites

- FCC issued guidance concerning small satellite licensing in 2013:
http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-13-445A1.pdf

- Large constellation projects
 - One Web
 - Boeing
 - And others
- FCC Status--
 - License processing round for Ku- and Ka-band initiated July 15, 2016. Competing applications due November 15, 2016.
 - License processing round for V-band initiated November 1, 2016. Competing applications due March 1, 2017.

What Next?



- Deployment of larger numbers of satellites, and more frequently
 - Continuing university/research activity
 - Multiple commercial cubesat and small satellite projects at various stages of development
 - Low cost launch alternatives
- Potential for several fold increase in active satellites, and for more satellites in the “retirement” phase

Updates to NGSO FSS Rules

- FCC rules contain the general regulatory framework for the operation of NGSO FSS constellations. Some possible refinements:
 - Off-axis EIRP density limits applicable to NGSO FSS uplink transmissions;
 - Refining definition of NGSO-NGSO in-line interference avoidance;
 - Incorporation of ITU EPFD limits for Ka-band into FCC rules
 - Changes to the U.S. Table of Frequency Allocations to accommodate FSS operations (including NGSO) that have been authorized on an ad-hoc basis
 - Modifications to FCC rules concerning geographic coverage and deadlines for deployment of approved networks
- Status: Draft Notice of Proposed Rule Making under review by Commissioners

Updates to Orbital Debris Mitigation Rules

- Updates to reflect improvements in technical criteria, primarily for LEO missions (e.g., to reflect NASA standards)
- Improvements to debris mitigation rules for constellations with large numbers of satellites, particularly for per satellite criteria (re-entry casualty risk, on-orbit collision risk)
- Reliability of post mission-disposal
- Maneuverability/Trackability
- Status: Draft Notice of Proposed Rule Making in later stages of preparation

Proceeding on Small Satellite Licensing

- Possible changes to capture licensing practices that have emerged during the past five to ten years of licensing small satellites.
- Possible changes or new licensing processes to better fit some typical small satellite characteristics, such as shorter mission duration, faster replenishment rates
- We also are planning to survey specific frequency bands that may be of particular importance for small satellites, and propose rule changes as appropriate for those frequency bands.
- Status: Draft Notice of Proposed Rule Making early next year.

- **Specification of Orbits and Number of Satellites**
 - License specifies ranges of orbits to accommodate opportunistic launches: may require analysis of worst case parameters, for example for signal strength or orbital lifetime
- **25 Year Rule and Large Numbers of Satellites**
 - Because large numbers of satellites are left on orbit for more than 25 years, we have asked larger constellations for an analysis of aggregate collision risk over the orbital lifetime of all satellites in a constellation
- **Reliability of Disposal Measures**
 - We are asking for additional reliability information on a case-by-case basis, particularly where compliance with the 25 year rule relies on active shortening of orbital lifetime through propulsion or drag enhancement.

- Collision Avoidance/Data Sharing
 - Because newer space actors may not have established relationships for data sharing, we are asking or requiring newer operators, particularly small satellite operators:
 - to establish a point of contact with the Joint Space Operations Center in order to assist in initial cataloging of satellites, and to receive conjunction warnings
 - To take necessary measures if a conjunction warning involving an active satellite is received, such as contacting the other operator, sharing data, or adjusting operations
 - Even if a satellite cannot be actively maneuvered, data sharing may save the other satellite operator from needing to maneuver

Conclusion

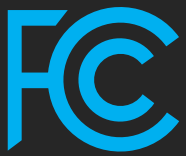


The FCC is updating its rules and licensing practices for orbital debris mitigation to address a future in which space is explored and used more intensively.

We appreciate very much the ITU's work to inform and educate new space operators, and to enable new space services.

Thank You

Space Situational Awareness



- The FCC role is regulatory, rather than operational.
- Provision of real-time space surveillance data and space object conjunction warnings to operators is not an appropriate FCC function.
- The role of FCC licensing in space surveillance and satellite traffic management is a supporting role, focused on encouraging, or requiring if necessary, operator-to-operator coordination.