



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

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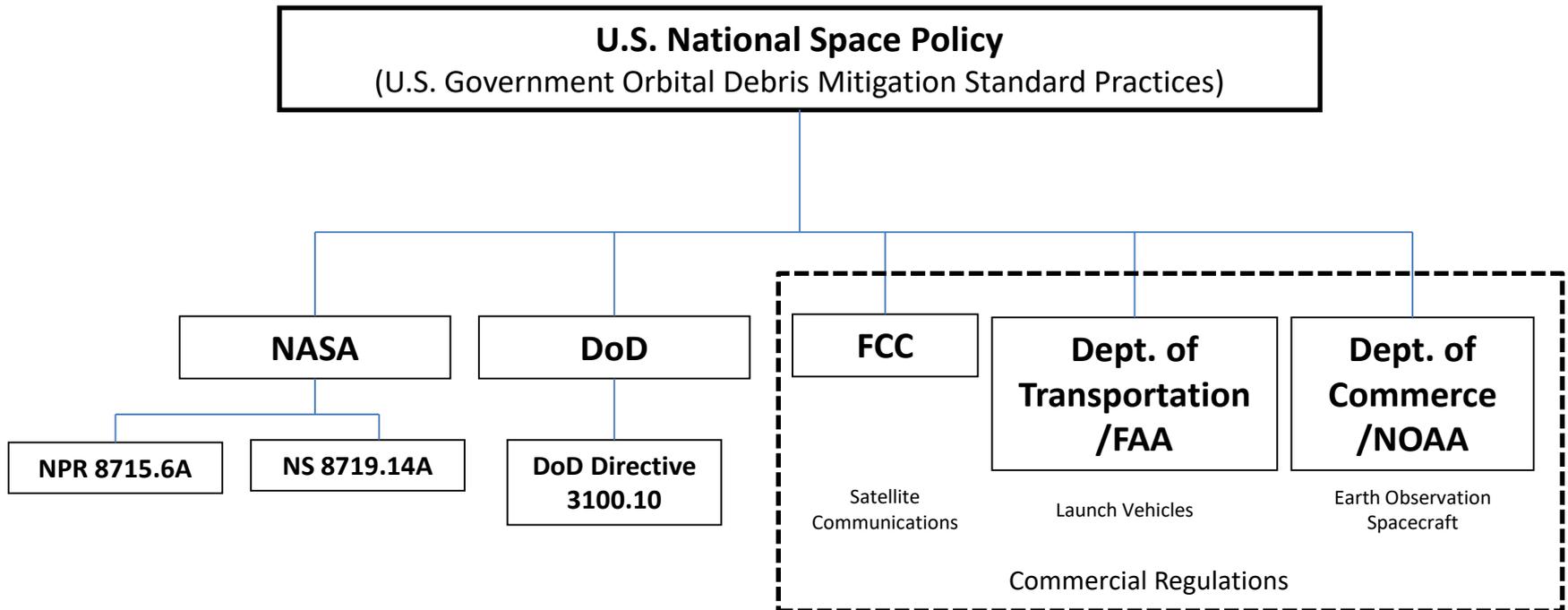
- U.S. National Legislation/ U.S. Agency Roles and Responsibilities
- FCC Licensing Processes and Approaches for Small Satellites
- Initiatives
 - Rule making activities
 - Licensing activities

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.

- **Three Satellite Processes (for non-Federal stations)**
 - “Part 25”--Regular Licensing
 - Experimental Licensing under Part 5 of the FCC Rules
 - Amateur Radio for communication by amateurs for permitted amateur radio purposes under Part 97 of the FCC Rules
- Process depends on the purpose of the satellite operations
- **Common features of all three processes:**
 - Orbital Debris Mitigation Plan Required
 - International Telecommunication Union (ITU) Filing (with ITU Cost recovery fees for Part 25 and most experimental)

FCC Licensing--Regular



- Primarily used for commercial services, but not limited to commercial service
- Requires a detailed technical and legal submission
- Application Fee
 - New NGSO: \$ 471,575.00/constellation
- Annual regulatory fees (recalculated annually)
 - NGSO (FY 2018): \$ 122,775/constellation
- 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 \$70
- Applicant must submit the appropriate ITU filing and commit to pay ITU cost recovery fees

Amateur Satellites



- FCC regulations permit amateur satellite operations if:
 - The station operates in appropriately allocated amateur frequency bands
 - The station apparatus is controlled by a person holding an amateur station license
 - The station is more than 50 km above the Earth's surface aboard “any craft that is documented or registered in the United States”
 - The communication is by amateurs for permitted amateur radio purposes (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 Satellites (cont'd)



- When is a craft “documented or registered in the United States”?
- The FCC requires a pre-launch filing including:
 - IARU Coordination letter
 - Detailed technical description of the design and operation of the spacecraft
 - SpaceCap file (for ITU submission)
 - Orbital debris mitigation plan
- A craft is considered “documented” when these materials are sufficient to justify submitting the ITU filing, and recommending to the Department of State that, from an FCC perspective, the satellite is sufficiently supervised to warrant registration by the U.S. with UNCOPUOS, consistent with U.S. treaty obligations
- There are no application or ITU cost recovery fees

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.

Small Satellite Licensing NPRM



- Notice of Proposed Rule Making adopted April 2018:
 - Seeks comment on special rules for small satellites:
 - A new application process for licensing Part 25 small satellites, involving lower application fee (\$30,000)
 - New process is optional—no changes proposed to FCC’s rules for the existing experimental, amateur processes
 - Proposed as an alternative for applicants, but would not replace existing licensing processes
- Comments and reply comments submitted fall of 2018; FCC staff analyzing and developing recommendations

Small Satellite NPRM (cont'd.)



- Proposed criteria for small satellites eligible to use the process:
 - 10 or fewer satellites under a single authorization
 - Satellite mass of 180 kg or less
 - Satellites on-orbit for five years or less
 - Deployment at or below 400 km (below ISS) if the satellite lacks propulsion
 - Identifiable by unique marker (to assist in cataloging and tracking)
 - Physical dimensions 10cm X 10cm X 10cm or greater.
 - No operational debris
 - Probability of large object collision during orbital lifetime $<.001$
 - Disposal via atmospheric re-entry with $E_c=0$
- NPRM sought comment on whether any criteria should be adjusted for missions beyond Earth orbit
- NPRM also sought comments on several frequency related matters, including: availability of certain frequency bands for small satellites; facilitation of coordination with federal users; and use of inter-satellite links

- FCC NPRM adopted November 15, 2018
 - First comprehensive look at the FCC’s orbital debris rules since their adoption in 2004
 - The proposed rule revisions are designed to improve and clarify the rules, based on experience gained in satellite licensing and improvements in mitigation guidelines and practices since 2004 (NASA guidelines, etc.)
 - Address market developments (large constellation deployments, etc.)
- Comments filed April 5, reply comments May 6

- September 2017 Report and Order modified NGSO FSS Spectrum Sharing Rules
 - Coordination among parties using overlapping spectrum to avoid unacceptable interference
 - Absent coordination, any commonly authorized frequency band will be divided among the affected satellite networks whenever $\Delta T/T$ in a link of any of these networks exceeds 6% ($\Delta T/T$ threshold substituted for the previously existing 10° avoidance angle threshold)
- GSO-NGSO Sharing
 - ITU EPFD Limits incorporated by reference
 - New rule states that, unless otherwise provided, NGSO systems must not cause unacceptable interference to, or claim protection from, GSO FSS or GSO BSS networks
- Milestone and Geographic Coverage Rules
 - Relaxes the NGSO milestone rules (50% of the total number of satellites in 6 years; remaining in 9 years)
 - Removes international geographic coverage rules

Earth Stations in Motion (ESIMs)



- September 2018 R&O amends the U.S. Table of Frequency Allocations to allow ESIM operation with GSO FSS space stations in the 18.3-18.8 GHz (↓), 19.7-20.2 GHz (↓), 28.35-28.6 GHz (↑), and 29.25-30 GHz (↑) frequency bands
 - These operations are characterized as an application within the fixed-satellite service and have primary status
- R&O also improves organizational structure and eliminates redundancy by:
 - Consolidating the technical, operational and application rules for C- and Ku-band ESVs, VMESs, and ESAAs into a single ESIM rule section in Part 25, and extend those rules to cover ESIM operations in the conventional Ka-band.
 - Eliminating repetition in certain ESIM rules by referring to existing provisions in other rules that apply to other GSO FSS earth stations.
- FNPRM seeks comment on expanding the frequencies available to ESIMs communicating with GSO FSS satellite networks to include the following ranges:
 - 10.7-10.95 GHz (↓), 11.2-11.45 GHz (↓), 17.8-18.3 (↓); 19.3-19.4 (↓); 19.6-19.7 (↓); 18.8-19.3 GHz (↓); 28.6-29.1 GHz (↑)
- November 2018 NPRM seeks comment on ESIM operations with NGSO FSS satellite networks

FCC Non-geostationary FSS Processing Rounds



- Processing round for Ku-and Ka-band initiated July 15, 2016
 - 12 companies total
 - 6 LEO; 3 MEO; 3 HEO/high inclination
 - Systems range from 2 satellites to 4,425 satellites, 3U cubesat to GSO-class bus
- Processing round for V-Band initiated November 1, 2016
 - 7 companies total—all are also participating in Ku-/Ka-band round
 - 3 propose V-band frequencies on previously proposed Ku-/Ka-band satellites
 - 4 propose new systems and/or additional satellites
- Chronology of Decisions:
 - June 22, 2017: Market Access Grant for OneWeb (UK)
 - November 3, 2017: Market Access Grant for Telesat (Canada) and Space Norway (Norway)
 - March 29, 2018: License grant to SpaceX
 - June 4, 2018: License grant to Audacy
 - June 6, 2018: Grant of O3B's request to modify market access
 - August 16, 2018: License grant to Karousel
 - November 15, 2018: License grant to SpaceX V-Band; Market Access Grant for Telesat V-Band (Canada), Kepler (Canada) and LeoSat (France/Netherlands)
 - April 26, 2019: License Modification granted for SpaceX
 - May 9, 2019: License granted to Theia

Ku/Ka-Band Processing Round



System (Date granted) * RF Inter-satellite Links	# of Satellites (Orbit Altitude)		Downlink	Uplink	Licensing Administration (Main Use)
OneWeb (Jun 23, 2017) (mod pending)	720 (1,200 km)	1980 (1,200 km)	10.7-12.7 GHz; 17.8-18.6 GHz 18.8-19.3 GHz	14.0-14.5 GHz; 27.5-29.1 GHz 29.5-30.0 GHz	UK (Broadband, including end user)
O3b/SES (Jun 6, 2018)	42 (8,062 km)		17.8-18.6 GHz; 18.8-20.2 GHz	27.5-30.0 GHz	UK (Broadband, including end user)
SpaceX (Mar 28, 2018) (Apr 26, 2019)	4425 (1,110-1,325 km)	4409 (550; 1,110-1,325 km)	10.7-12.7 GHz; 17.8-18.6 GHz 18.8-19.3 GHz; 19.7-20.2 GHz	12.75-13.25 GHz; 13.85-14.5 GHz 27.5-29.1 GHz; 29.5-30.0 GHz	US (Broadband, including end user)
Boeing (withdrawn)	60 (Apogee 44,221 km; Perigee 27,355 km)		17.8-20.2 GHz	27.6-30 GHz	US (Broadband, including end user)
Telesat Canada (Nov 3, 2017)	117 (1,000-1,248 km)		17.8-18.6 GHz; 18.8-19.3 GHz 19.7-20.2 GHz	27.5-29.1 GHz; 29.5-30.0 GHz	Canada (Broadband, including end user)
LeoSat (Nov 15, 2018)	78 (1,400 km)		17.8-18.6 GHz; 18.8-19.3 GHz 19.6-20.2 GHz	27.5-29.1 GHz; 29.5-30.0 GHz	Netherlands (Premise-to-premise)
Audacy Corporation* (Jun 6, 2018)	3 (13,890 km)		19.7-20.2 GHz	29.5-30.0 GHz	US (Commercial tracking and data relay)
Theia Holdings A Inc.* (May 9, 2019)	112 (800 km)		10.7-12.2 GHz; 17.8 18.6 GHz; 18.8-19.3 GHz; 19.6-20.2 GHz	12.75-13.25 GHz; 14-14.5 GHz 27.5-30.0 GHz	US (Remote Sensing SAR)
Kepler Communications Inc. (Nov 15, 2018)	140 (500-650 km)		10.7-12.7 GHz	14.0-14.5 GHz	Canada (IoT data aggregation & backhaul)
ViaSat, Inc.*	20 (8,200 km)		17.8-18.6 GHz 18.8-19.3 GHz; 19.7-20.2 GHz	27.5-29.1 GHz; 29.5-30.0 GHz	Netherlands (Broadband, including end user)
Karousel LLC (Aug 16, 2018)	12 (Apogee 44,002.3 km; Perigee 31,569.5 km)		10.7-12.7 GHz; 17.8-19.3 GHz 19.7-20.2 GHz	14.0-14.5 GHz; 27.5-29.1 GHz 29.5-30.0 GHz	US (Video & data distribution)
Space Norway AS (Nov 3, 2017)	2 (Apogee 43,509 km; Perigee 8,089 km)		10.7-12.7 GHz; 19.7-20.2 GHz	14-14.5 GHz; 29.5-3- GHz	Norway (Broadband to high-latitude end user)

V-Band Processing Round



- Downlink Frequencies: 37.5-42 GHz; Uplink Frequencies: 47.2-50.2 GHz; 50.4-51.4 GHz

System	# of Satellites (Orbit Altitude)	Licensing Administration (Main use)
Boeing (withdrawn)	2956 (970-1,082 km)	US (Broadband, including end user)
O3b/SES (Jun 6, 2018)	16 of the 42 using Ku/Ka (8,062 km)	UK (Broadband, including end user)
SpaceX (Nov 15, 2018)	Some of the 4425 using Ka (1,110-1,325 km) + 7,518 (1,100-1,325 km)	US (Broadband, including end user)
Boeing 2	132 (1,056 km) + 15 (Apogee 44,221 km; Perigee 27,355 km)	US (Broadband, including end user)
Telesat Canada (Nov 15, 2018)	117 (follow-on to the 117 using Ka) (1,000-1,248 km)	Canada (Broadband, including end user)
ViaSat	20 (same using Ka) (8,200 km)	Netherlands (Broadband, including end user)
Audacy Corporation (Jun 6, 2018)	3 (same using Ka) (13,890 km)	US (Commercial tracking and data relay)
Theia Holdings A Inc.	112 (same using Ku/Ka) (800 km)	US (Remote Sensing SAR)
OneWeb	720 (same using Ku/Ka) (1,200 km) + 1280 (8,500 km)	UK (Broadband, including end user)

Additional Materials



- A public notice discussing small satellite licensing:
 - “Guidance on Obtaining Licenses for Small Satellites” dated March 15, 2013
<https://www.fcc.gov/document/guidance-obtaining-licenses-small-satellites>
- An enforcement advisory concerning licensing requirements:
 - “Compliance with Satellite Communications Licensing Requirements is Mandatory and Failure to Comply Can Result in Enforcement Action” dated April 12, 2018
<https://www.fcc.gov/document/enforcement-advisory-satellite-communications-licensing>

Thank You