Promoting a Competitive and Innovative Satellite Telecommunications Marketplace

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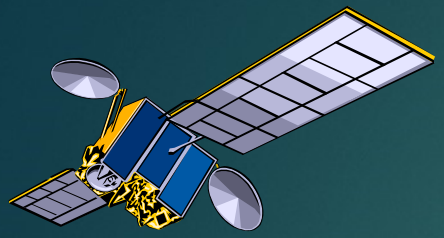
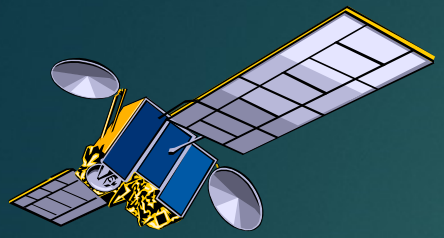
Overview of Recent FCC Satellite Regulatory Activities

- Active area within FCC/International Bureau over the past two years
- Significant focus on new NGSO systems
- Updating and streamlining existing regulatory frameworks as well as crafting new frameworks
- Licensing
- Open and transparent process



Two Broad Classes of NGSO Satellite Systems

- Long Duration Missions
  - Usually large constellations
  - Commercial projects generally with significant capital investments
  - Exclusive or some use of FSS frequencies
  - Existing regulatory framework (Part 25 of FCC Rules), recently streamlined (September 2017)
- Short Duration Missions
  - Smaller satellites
  - Small number of satellites in the constellation
  - Non-commercial or early start-up phase
  - Some currently licensed in the “experimental radio service” (Part 5 of FCC Rules) or in the amateur-satellite service (Part 97 of FCC Rules)
  - Final rules adopted in August 2019 created an alternative streamlined process that could accommodate some of these missions

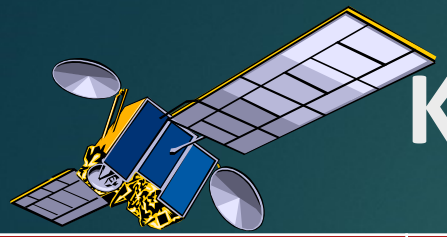


Long Duration Missions

- Two parallel tracks
  - Consideration of several NGSO FSS constellations applying for an FCC license or for US market access
  - Streamlining the FCC's rules to facilitate the deployment of these NGSO FSS satellite systems

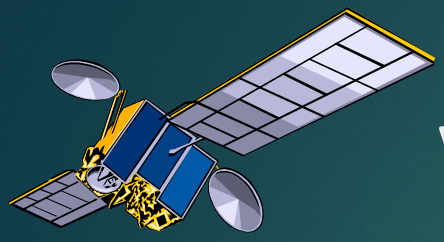
NGSO FSS "Processing Rounds"

- 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
  - 8 companies total—all are also participating in Ku-/Ka-band round
    - 4 propose V-band frequencies on previously proposed Ku-/Ka-band satellites
    - 4 propose new systems and/or additional satellites
- Actions to Date
    - Licenses and or market access granted to 10 companies
    - Over 13,000 satellites



Ku/Ka-Band Processing Round

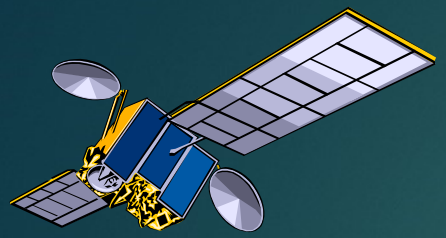
System (Date granted) * RF Inter-satellite Links	# of Satellites (Orbit Altitude)		Downlink	Uplink	Licensing Administration (Main Use)
OneWeb (Jun 23, 2017) (mod pending)	720 (1,200 km)	1980 (1,200 km)	10.7-12.7 GHz; 17.8-18.6 GHz 18.8-19.3 GHz	14.0-14.5 GHz; 27.5-29.1 GHz 29.5-30.0 GHz	UK (Broadband, 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; Perigee27,355 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* (June 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; 29.5-30- GHz	Norway (Broadband to high-latitude end user)



V-Band Processing Round

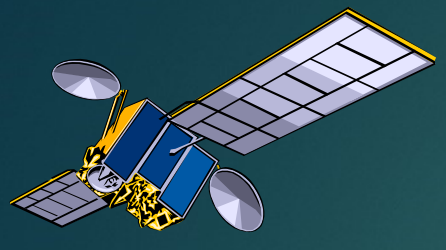
- Downlink Frequencies: 37.5-42 GHz; Uplink Frequencies: 47.2-50.2 GHz; 50.4-51.4 GHz

System (Date granted)	Number of Satellites (Orbit Altitude)	Licensing Administration (Main use)
Boeing (withdrawn)	2956 (970-1,082 km)	US (Broadband, including end user)
O3b/SES (June 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	24 (same using Ka) (8,200 km)	Netherlands (Broadband, including end user)
Audacy Corporation (June 6, 2018)	3 (same using Ka) (13,890 km)	US (Commercial tracking and data relay)
Theia Holdings A Inc. (May 9, 2019)	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)



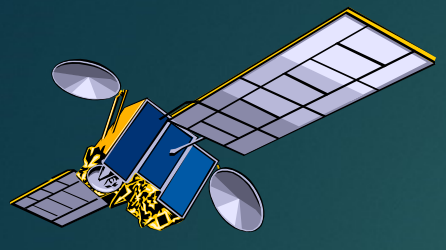
2017 NGSO FSS Report and Order (1)

- Changes to the Ka-band Plan to accommodate NGSO and GSO operations that have been authorized through waivers of the Ka-band Plan
  - FSS secondary allocation in 17.8-18.3 GHz
  - GSO FSS primary designations: 19.3-19.4 GHz & 19.6-19.7 GHz
  - Secondary FSS designations: NGSO (18.3-18.6 GHz); GSO (18.8-19.3 GHz)
  - Removal of FS & MS allocations: 28.35-29.1 GHz; 29.25-29.5 GHz
- NGSO FSS Spectrum Sharing
  - 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)



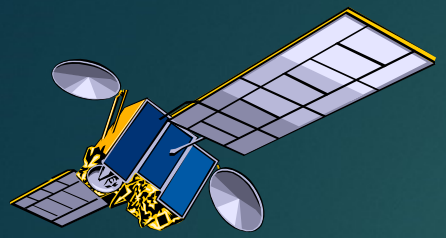
2017 NGSO FSS Report and Order (2)

- GSO-NGSO Sharing
  - ITU EPFD Limits have been 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
  - Sharing regime in 18.8-19.3 GHz and 28.6-29.1 GHz
- Geographic Coverage Rules
  - Removes international geographic coverage rules
  - Follow-on proceeding invites comment on whether to remove the U.S. coverage requirement for NGSO FSS systems



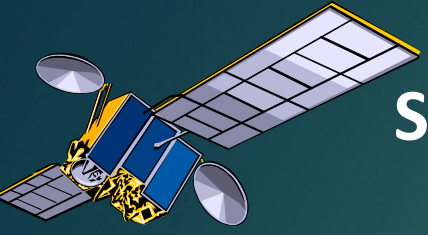
2017 NGSO FSS Report and Order (3)

- Previous NGSO milestone – deploy full constellation within 6 years and failure to satisfy will result in loss of authorization and forfeiture of up to $5 million of posted surety bond
- NGSO FSS proceeding, proposed to relax the milestone to allow more flexibility in system design and implementation in light of proposals to launch and operate thousands of satellites
- September 2017 FCC Decision (NGSO FCC Report and Order)
  - Relaxed the NGSO milestone rules
    - Striking the right balance between need for flexibility and potential warehousing
    - Deploy 50% of the total number of authorized satellites in 6 years; remaining in 9 years
    - Failure to meet the milestone, authorization will be reduced to the number of satellites in use on the milestone date; bond is forfeited



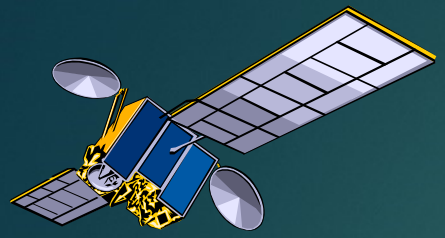
Short Duration Missions: The Need for a New Approach

- FCC experimental licenses impose significant limits on the scope of small satellite short duration missions
  - e.g., are not intended to cover commercial operations; and do not afford protected status to communication links
- For different reasons, current satellite rules are also ill-suited for many short duration mission applications
  - NGSO rules were drafted primarily for larger, longer-duration satellite missions
  - NGSO licensing and regulatory fees are often disproportionate to the cost of building, launching, and operating a small satellite
  - Processing, bond, and milestone timelines do not accurately reflect the short operational lifetime of small satellites



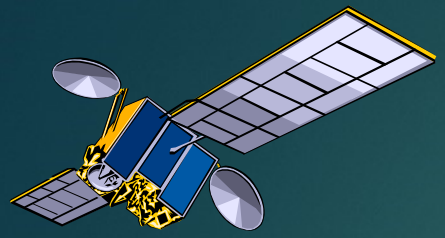
Small Satellite Short Duration Missions August 2019 Rules

- Adopted streamlined application process can be used by systems meeting certain characteristics, including, for example:
  - 10 or fewer satellites under a single authorization
  - Total on-orbit lifetime of satellite(s) of six years or less
  - Propulsion capabilities or deployment below 600 km altitude
  - Relatively low risk from an orbital debris perspective, as assessed through additional clearly ascertainable characteristics
- Adopted streamlined application process
  - Exempts qualified applicants from the Commission's processing round procedures, but requires applicants to certify that they will not cause interference to existing operators or unreasonably preclude future operators from utilizing the same frequency bands.
  - Provides a grace period from posting of the surety bond



Other Recent FCC Actions: ESIMS Communicating with GSOs

- September 2018 Report and Order adopted a decision to re-organize and streamline current rules governing ESIM communications with GSO satellites operating in the C- and Ku-bands
- Amended 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
  - Operations are characterized as an application within the fixed-satellite service and have primary status
- Improved organizational structure and eliminates redundancy of rules
- Included a further NPRM that 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 (↑)



Other Recent FCC Actions: ESIMS Communicating with NGSOs

- November 2018 Notice of Proposed Rulemaking proposes framework to cover communications with NGSO satellites operating in the FSS
- Seeks comment on allowing ESIMs to communicate with NGSO FSS satellites in many of the same conventional Ku-band, extended Ku-band and Ka-band frequencies as permitted for communications with GSO FSS systems, including:
  - Communications with NGSO FSS satellites on a primary basis: 18.8-19.3 GHz and 28.6-29.1 GHz
  - Communicates with NGSO FSS satellites on a primary basis: 11.7-12.2 GHz, 14.0-14.5 GHz, 18.3-18.6 GHz,19.7-20.2 GHz, 28.35-28.6 GHz and 29.5-30.0 GHz, provided they do not cause harmful interference to, or claim protection from GSO FSS networks
  - To receive signals from NGSO FSS systems in the following bands on an unprotected basis, with respect to transmissions from non-Federal fixed service stations: 10.7-11.7 GHz; 19.3-19.4 GHz, 19.6-19.7 GHz
  - To receive signals from NGSO FSS systems on a secondary basis in the 17.8-18.3 GHz band
- Public Comment: Comments filed February 11, 2019; replies March 14, 2019
- Next steps: Review public comments; staff will prepare recommendations

Orbital Debris NPRM

- November 2018, the FCC adopted an NPRM, which represents the first comprehensive look at the Commission'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 by the Commission in satellite licensing;
  - Consider improvements in mitigation guidelines and practices since 2004; and
  - Address various market and technological developments, for example:
    - Planned large NGSO satellite constellations (e.g., SpaceX, OneWeb), and
    - Increasing use of relatively inexpensive small satellites, such as CubeSats

Orbital Debris NPRM Overview

Over-Arching Topics Include:

- Seeking comment on the suitability of various orbital debris mitigation guidance and standards for application in the FCC licensing process.
- Seeking comment on whether there are any areas in which proposed requirements may overlap with requirements that are clearly within the authority of other U.S. agencies, so that we may seek to avoid duplicative activities. We ask whether exceptions to application of our rules may be appropriate in particular circumstances. We would expect to take into consideration ongoing developments within and among other agencies.

Public Comment Phase:

Comments filed April 5, 2019; reply comments filed May 6, 2019

Next Steps: Review of public comments; staff developing recommended decisions

Questions?

NGSO FSS Report and Order

https://docs.fcc.gov/public/attachments/FCC-17-122A1.pdf

Orbital Debris NPRM

https://docs.fcc.gov/public/attachments/FCC-18-159A1.pdf

ESIMS NGSO NPRM

https://docs.fcc.gov/public/attachments/FCC-18-160A1.pdf

Small Satellite Report and Order

https://docs.fcc.gov/public/attachments/FCC-19-81A1.pdf

THANK YOU!

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