TCB Workshop
Rules Update

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15 April 2019

Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission

White Space Devices

Recent Rule Changes (ET 16-56)

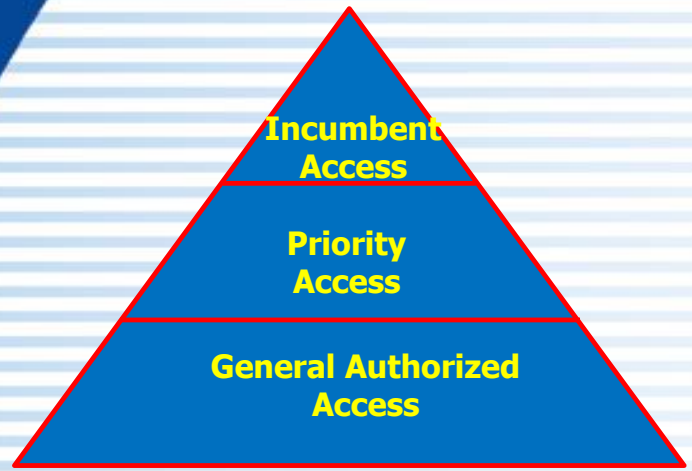
Report and Order

- Require all fixed white space devices to incorporate geolocation capability
  - External geolocation source permitted in areas where internal capability does not work
    - Not permitted as permissive change
    - Effective date – 6 months after rules become effective
      - Not yet published in Federal Register
- Clarify responsible party regarding registration data accuracy
  - Operator of fixed white space device

Order on Reconsideration

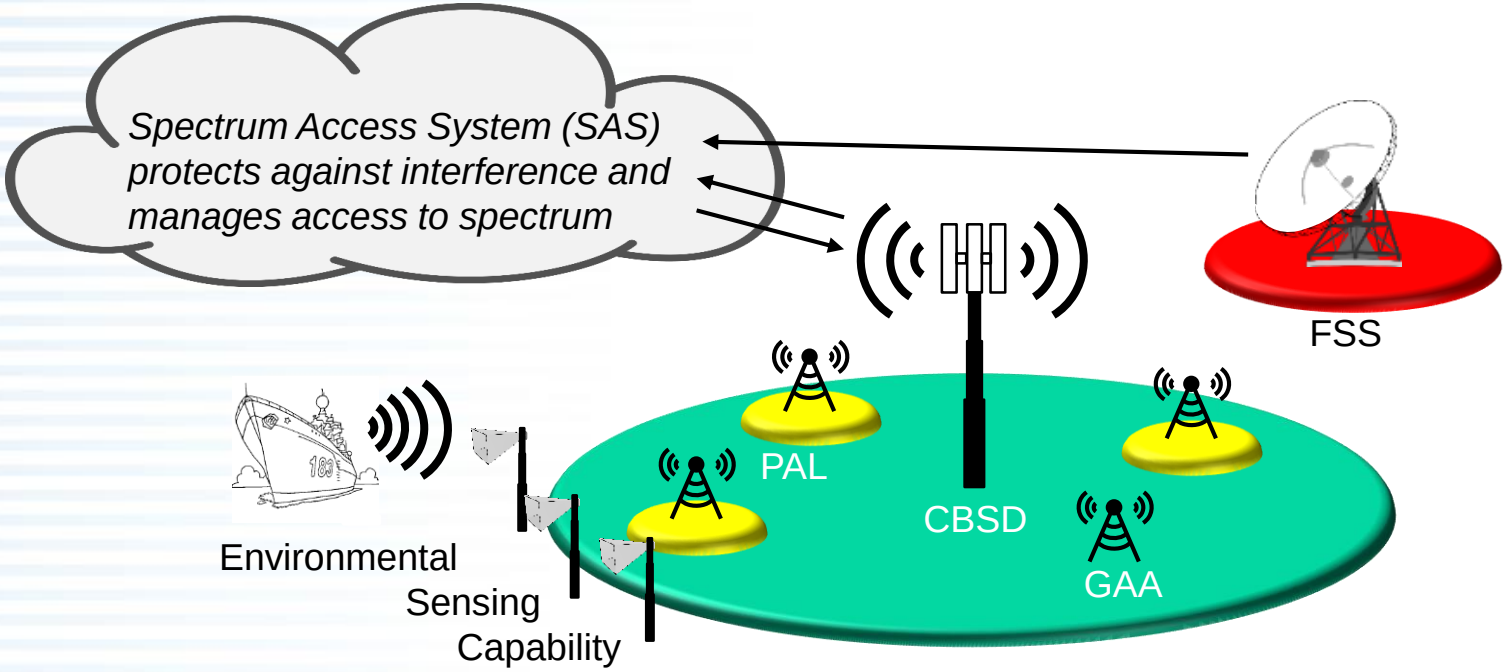
- Antenna AGL increased to 100m from 30m in less congested areas
  - No increase in HAAT limit (250m maximum)

Citizens Broadband Radio Service (3.5 GHz)



Spectrum sharing across three tiers

Dynamic Spectrum Access



- **Multi-stakeholder process -** WinnForum developing implementation
- **Conditionally approved first Spectrum Access Administrators**: Amdocs; Comsearch, CTIA, Federated Wireless, Google; Key Bridge; and Sony
- **SAS testing by NTIA** Institute for Telecommunications Science
- **Initial commercial deployments** – Applications under review by FCC

Spectrum Horizons

Report & Order adopted March 15, 2019 (ET 18-21)

- **FCC expanded access above 95 GHz**
  - Total of 21.2 GHz for unlicensed use
    - 116-123 GHz, 174.8-182 GHz, 185-190 GHz and 244-246 GHz, bands
    - Similar to 60 GHz rules
    - Selected high absorption bands to enable sharing with passive services
      - Earth Exploration Satellite Service
      - Space Research Service
      - Radio Astronomy Service
  - New type of experimental licenses > 95 GHz
    - Longer license terms
    - Ability to sell devices

Much of the spectrum above 95 GHz is allocated for passive services

Achieve Fiber Capacity

Innovations

Spectrum Horizons

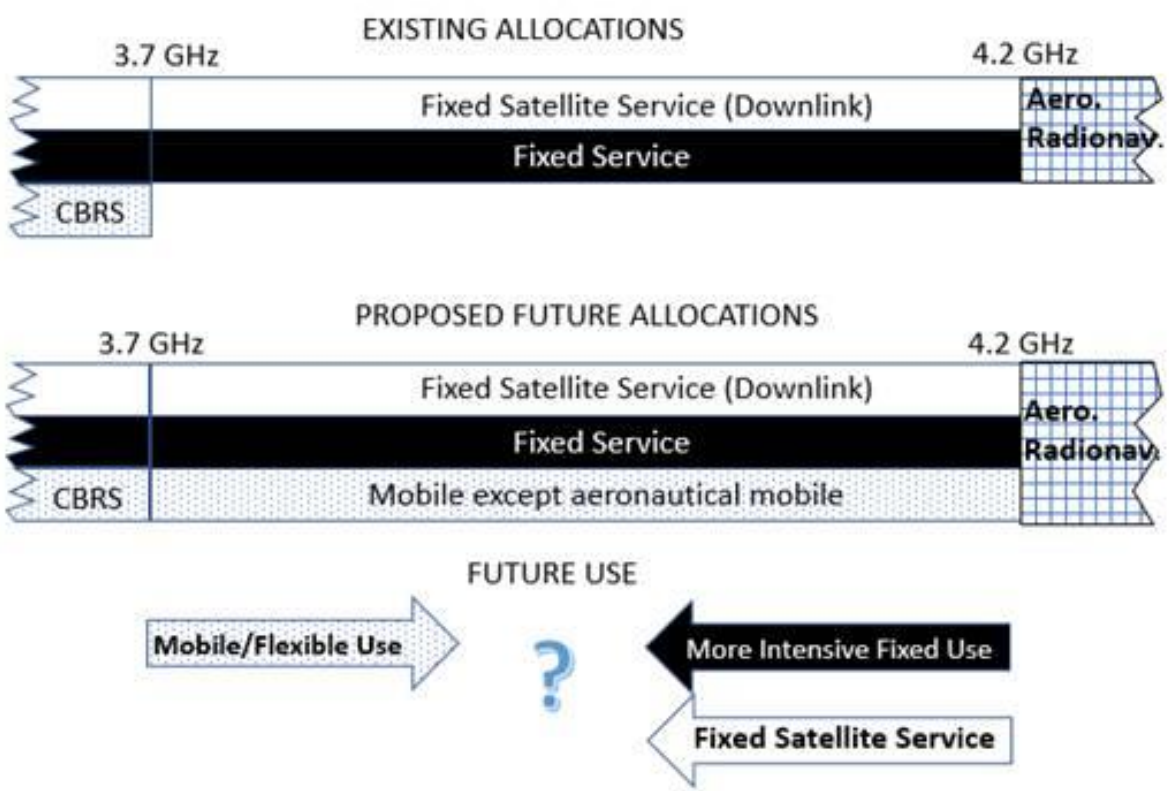
Technical Rules
(Based on 54-71 GHz Band Rules)

- **Power**
  - General limit
    - Maximum EIRP of 40 dBm (average) and 43 dBm (peak)
  - Fixed point-to-point devices
    - Maximum EIRP of 82 dBm (average) and 85 dBm (peak)
    - Minimum gain of 51 dBi; 2 dB reduction in the maximum EIRP for each dB the antenna gain falls below 51 dBi.
  - Measured with detection bandwidth that encompasses the band of operation
  - No maximum conducted power specified
    - Assumes majority of devices will not have detachable antenna
  - Operation with less than 100 megahertz bandwidth must reduce PSD to levels of a device operating with 100 megahertz bandwidth
- **Out-of-Band-Emissions**
  - Limited to 90 pW / sq. cm. at 3 meters (equivalent to -10 dBm EIRP)
  - Applicable above 40 GHz and up to third harmonic
    - 15.209 limit below 40 GHz

Mid-Band: 3.7-4.2 GHz C-Band Downlink

NPRM Adopted July, 2018 (GN 18-122)

- Proposal: Make spectrum available for licensed wireless service
- **Significance**: 3.7 GHz is adjacent to 3.5 GHz band – region of spectrum is a focus for 5G internationally

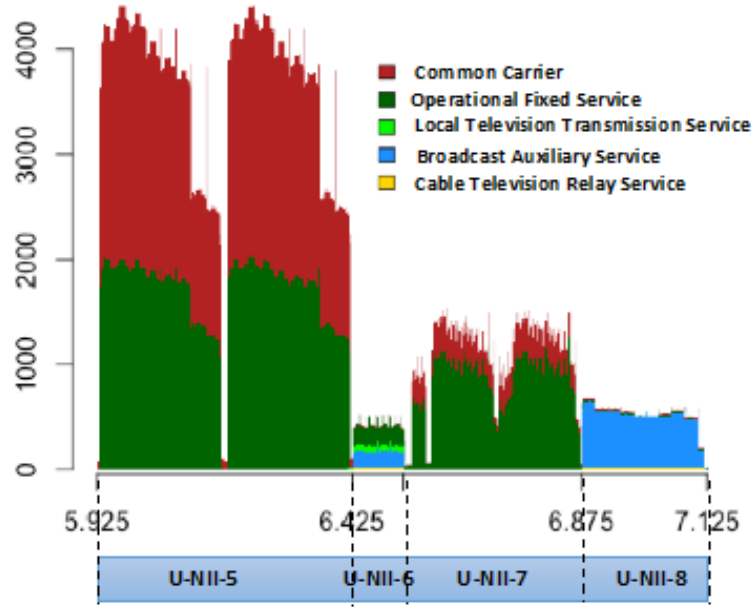


Mid Band: 6 GHz C-Band Downlink

NPRM Adopted October, 2018 (ET 18-295)

- Proposal: Make spectrum available for unlicensed access in the 5.925 – 7.125 GHz (6 GHz) band
- **Significance**: 6 GHz is close to 5 GHz unlicensed bands

Band (GHz)	Primary Allocations	Reference used in this NPRM[63]	Devices
5.925-6.425	Fixed Service FSS	U-NII-5	Standard-Power Access Point
6.425-6.525	Mobile Service FSS	U-NII-6	Low-Power Access Point
6.525-6.875	Fixed Service FSS	U-NII-7	Standard-Power Access Point
6.875-7.125	Fixed Service Mobile Service FSS	U-NII-8	Low-Power Access Point



U-NII-5 / U-NII-7 would rely on Automated Frequency Coordination (AFC)

Sharing with microwave links, Broadcast Auxiliary Services, Fixed Satellite Receive Stations, etc.

Mid Band: 6 GHz C-Band Downlink

Proposed Technical Rules

- **Automated frequency coordination – similar to white space database**
  - Prevents co-channel operation within fixed link exclusion zone
- **Power**
  - U-NII-5 and U-NII-7 Standard-Power Access Points
    - Maximum conducted output power of 1 watt
    - Maximum power spectral density of 17 dBm in any 1 megahertz band
  - U-NII-6 and U-NII-8 band Low-Power Access Points
    - Maximum conducted output power of 250 milliwatts
    - Maximum power spectral density of 11 dBm in any 1 megahertz band
  - Client Devices
    - Maximum conducted output power of 63 milliwatts
    - Maximum power spectral density of 5 dBm in any 1 megahertz band
  - For antennas with directional gain greater than 6 dBi, the maximum power and power spectral density shall be reduced by a 1:1 ratio
- **Out-of-Band Emission Limits**
  - EIRP of -27 dBm/MHz at band edges

High Band: Spectrum Frontiers

First Report and Order Bands - 2016

	28 GHz	37 GHz	39 GHz	64-71 GHz
Frequency	27.5-28.35 GHz	37-38.6 GHz	38.6-40 GHz	64-71 GHz
Bandwidth	850 MHz	1600 MHz	1400 MHz	7000 MHz
Terrestrial Allocation	Licensed for fixed operations, with about 75% of the population covered by existing licenses; remaining licenses in inventory	Yes (no current use)	Licensed for fixed operations, with about 50% of the population covered by existing licenses; the remaining licenses are in inventory.	Yes (no current use)
Federal Allocation	No	Radio Astronomy / Space Research in 37-38 GHz @ 3 sites; Federal Fixed/Mobile in 37-38.6 GHz @ 14 locations	Fixed Satellite Service / Mobile Satellite Service in 39.5-40 (military use only)	Earth Exploration Satellite Fixed/Mobile/Satellite
Satellite Allocation	Yes (Uplink)	Yes (no current use)	Yes (no current use)	Yes (no current use)
Licensing Scheme	Licensed	Licensed	Licensed	Unlicensed
Auction	Concluded January, 2019 $700M Gross Bids for 2,965 Licensed	December 2019	December 2019	

Granted incumbent fixed licensees authority to offer mobile service; led to market transactions

Lower 600 MHz identified for sharing between Federal Government and Private Sector - - invited comment on sharing method

Satellite/terrestrial sharing accomplished by well defined protections & rights

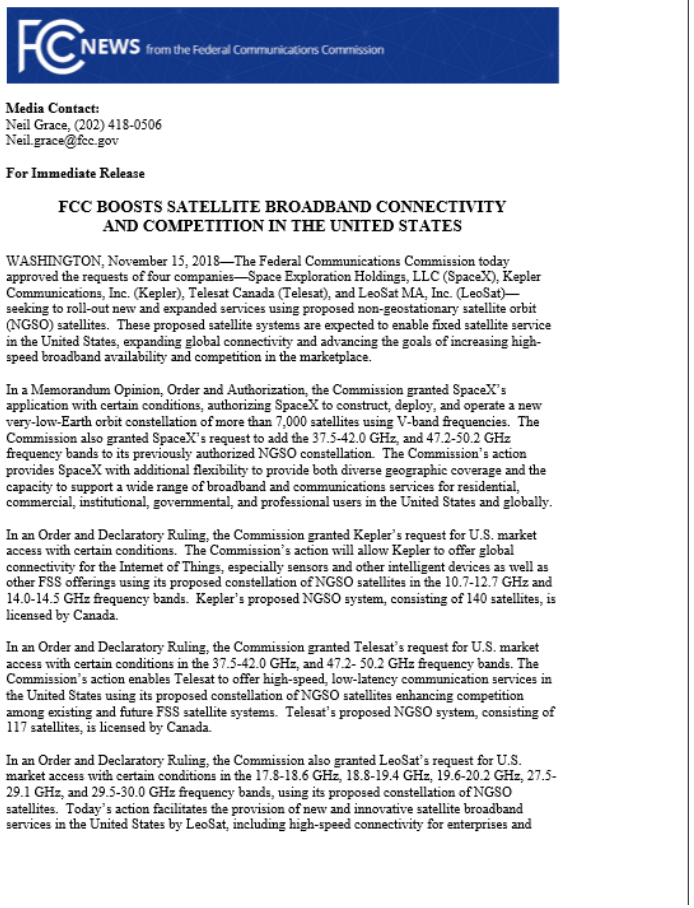
High Band: Spectrum Frontiers

Second Report and Order Bands -2017

	24 GHz	*47 GHz*
Frequency	24.25-24.45 GHz and 24.75-25.25 GHz	47.2-48.2 GHz
Bandwidth	700 MHz	1000 MHz
Terrestrial Allocation	Lower segment is licensed for two types of fixed operations: 24 GHz service and Digital Electronic Messaging Service (DEMS). 5 active 24 GHz licenses, and 38 active DEMS licenses; remaining licenses in inventory	Yes (no current use)
Federal Allocation	No	No
Satellite Allocation	Yes, 24.75-25.25 GHz band segment is non-Federal allocated for FSS (Earth-to-space)	Yes (no current use and the Commission designated this band for terrestrial use)
Licensing Scheme	Licensed	Licensed
Auction	Began March 14, 2019 and is Ongoing Almost $2B in gross bids on 2,909 licenses (as of April 15, 2019)	December 2019

Satellite Services

- Satellite services will play a vital role in 5G
- Proposed constellations of satellites in NGSO orbits offer Internet and other advanced services
- Identified MMW spectrum for satellite systems
- Approved 1st systems in 2017: SpaceX & OneWeb; subsequently SES, O3B, and others
- Space Month – November 2018:
  - Approved four separate petitions from companies seeking to initiate or expand services for low-earth-orbit satellite constellations
  - Authorized Galileo Global Navigation System service in the U.S.
  - Proposed to update rules for orbital debris
  - Proposed additional rules to facilitate E-SIMs
  - Proposed further streamlining of satellite licensing rules



FCC NEWS from the Federal Communications Commission

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For Immediate Release

FCC BOOSTS SATELLITE BROADBAND CONNECTIVITY AND COMPETITION IN THE UNITED STATES

WASHINGTON, November 15, 2018—The Federal Communications Commission today approved the requests of four companies—Space Exploration Holdings, LLC (SpaceX), Kepler Communications, Inc. (Kepler), Telesat Canada (Telesat), and LeoSat MA, Inc. (LeoSat)—seeking to roll-out new and expanded services using proposed non-geostationary satellite orbit (NGSO) satellites. These proposed satellite systems are expected to enable fixed satellite service in the United States, expanding global connectivity and advancing the goals of increasing high-speed broadband availability and competition in the marketplace.

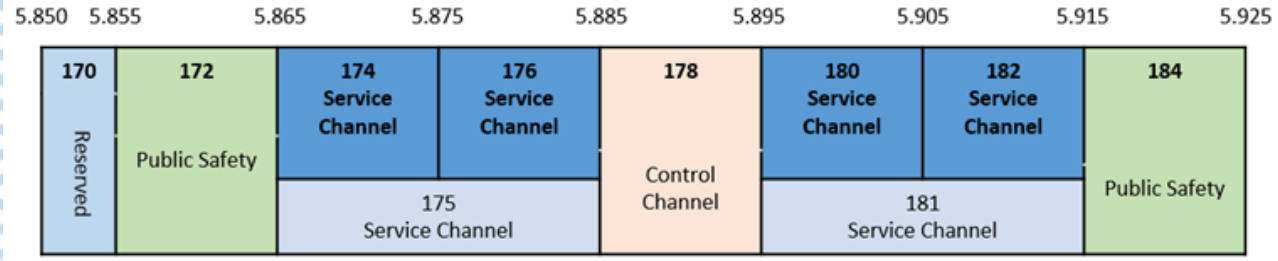
In a Memorandum Opinion, Order and Authorization, the Commission granted SpaceX's application with certain conditions, authorizing SpaceX to construct, deploy, and operate a new very-low-Earth orbit constellation of more than 7,000 satellites using V-band frequencies. The Commission also granted SpaceX's request to add the 37.5-42.0 GHz, and 47.2-50.2 GHz frequency bands to its previously authorized NGSO constellation. The Commission's action provides SpaceX with additional flexibility to provide both diverse geographic coverage and the capacity to support a wide range of broadband and communications services for residential, commercial, institutional, governmental, and professional users in the United States and globally.

In an Order and Declaratory Ruling, the Commission granted Kepler's request for U.S. market access with certain conditions. The Commission's action will allow Kepler to offer global connectivity for the Internet of Things, especially sensors and other intelligent devices as well as other FSS offerings using its proposed constellation of NGSO satellites in the 10.7-12.7 GHz and 14.0-14.5 GHz frequency bands. Kepler's proposed NGSO system, consisting of 140 satellites, is licensed by Canada.

In an Order and Declaratory Ruling, the Commission granted Telesat's request for U.S. market access with certain conditions in the 37.5-42.0 GHz, and 47.2- 50.2 GHz frequency bands. The Commission's action enables Telesat to offer high-speed, low-latency communication services in the United States using its proposed constellation of NGSO satellites enhancing competition among existing and future FSS satellite systems. Telesat's proposed NGSO system, consisting of 117 satellites, is licensed by Canada.

In an Order and Declaratory Ruling, the Commission also granted LeoSat's request for U.S. market access with certain conditions in the 17.8-18.6 GHz, 18.8-19.4 GHz, 19.6-20.2 GHz, 27.5-29.1 GHz, and 29.5-30.0 GHz frequency bands, using its proposed constellation of NGSO satellites. Today's action facilitates the provision of new and innovative satellite broadband services in the United States by LeoSat, including high-speed connectivity for enterprises and

Wi-Fi Sharing With Intelligent Transportation at Systems at 5.9 GHz

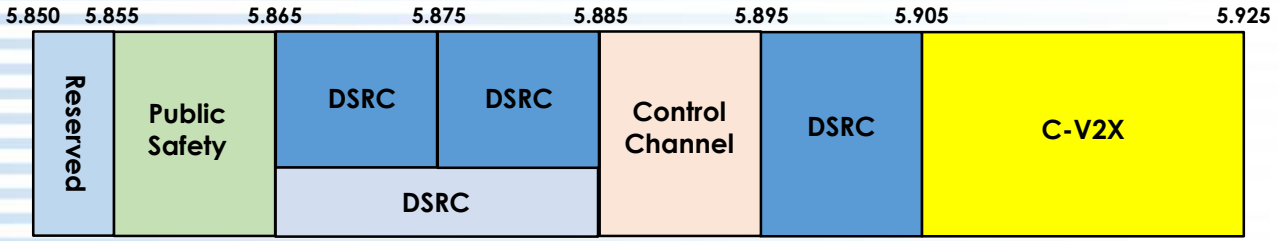


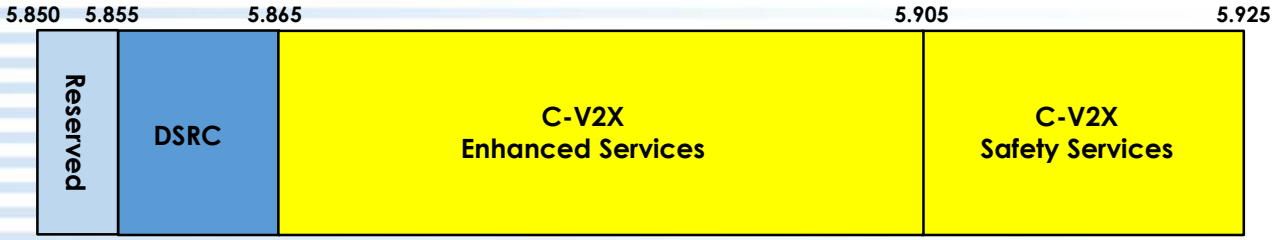
Dedicated Short Range Communications (DSRC) Channel Plan

U-NII Prototype device testing report issued October, 2018 (ET 13-49)

- Devices can detect DSRC and implement post detection steps

New Developments – Cellular Vehicle to Everything (C-V2X)





C-V2X Waiver Petition to use 20 megahertz channel at top of band (ET 18-357)

Ex parte filing ultimately seeking 20 megahertz and 40 megahertz channels for C-V2X

Recent OET Waivers Granted

- **Google – Project Soli - Adopted Dec. 31, 2018 – DA 18-1308**
  - Radars used for Short Range Interactive Motion Sensing in the 57-64 GHz band
  - Waiver of Section 15.255(c)(3) to allow Soli to operate:
    - At peak conducted power of +10 dBm (instead of -10 dBm as permitted in rules),
    - At peak EIRP level of +13 dBm (instead of +10 dBm as permitted in rules)
  - Additional provisions
    - Operate at a peak power spectral density (PSD) level of +13 dBm/MHz
    - Limit the transmit duty cycle to 10 percent in any 33 millisecond interval

- **32 Technologies – Adopted Nov. 30, 2018 – DA 18-1210**
  - Waiver of Part 15 wideband systems rules to allow marketing and use of fixed outdoor infrastructure for a pet collar using the 6.240-6.740 GHz band

Recent OET Waiver Requests on Public Notice

- MIT – Indoor medical monitoring device (Docket 19-89)
  - 15.503(d) – Definition of fractional bandwidth
  - 15.31(c) and 15.521(d) – Measurement standards and procedures
- Rohde & Schwarz - Security Scanning Device (Docket 19-88)
  - 15.205(a) – Operation in a restricted band
  - 15.231(b) – Field strength
- Auspion USA - Wireless Power Transfer Device (Docket 19-83)
  - 18.107(c) – Definition of local RF energy use
- Metrom Rail - UWB Positive Train Control System (Docket 18-284)
  - 15.519(a) – Use of fixed outdoor infrastructure in 6 GHz band
  - 15.519(c) – Increase of 6 dB radiated power

And the waivers keep on coming …

Thank You!