

Spectrum for Sensors in the Age of Automation and IoT



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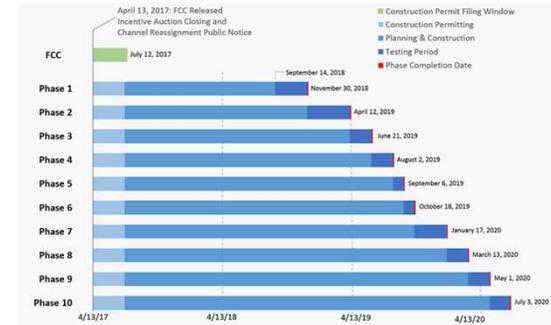
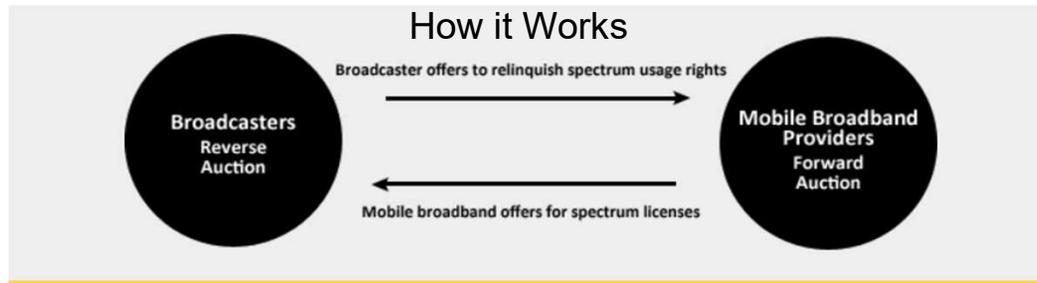
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Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission

Key FCC Spectrum Initiatives & Proceedings

- **Low Frequency Spectrum:**
 - Broadcast Incentive Auction (600 MHz band)
- **Mid Frequency Spectrum:**
 - 3.5 GHz (3550-3700 MHz)
 - Mid-Band Spectrum Notice of Inquiry (3.7 GHz to 24 GHz)
 - 6 GHz U-NII Band (5925-7125 MHz)
- **High Frequency Spectrum:**
 - Spectrum Frontiers (above 24 GHz)
 - Spectrum Horizons (above 95 GHz)

Low Band: TV Incentive Auction (600 MHz) band

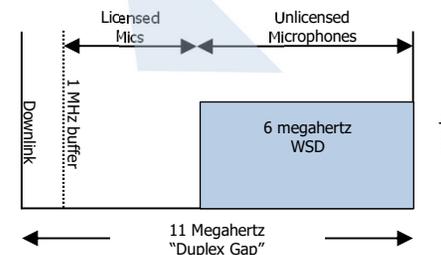


Ten Phase Transition Plan

- Reverse Auction
 - Ended January 13, 2017 – Stage 4; 84 megahertz clearing target



- Forward Auction Ended 2/10/17
- 39 month transition period began 4/13/17
- First licenses were issued 6/15/17
- Post-Incentive Auction Special Displacement Window 4/10/18 – 6/1/18



Citizen's Broadband Radio Service (3.5 GHz)

CBRS – A New Opportunity for Verticals

- Based on sophisticated spectrum access system
- Multi-stakeholder process developed details
- Widespread support – combines licensed and unlicensed models
- FCC has approved SAS's, Initial Commercial Deployments (ICDs) & Devices
- Opens the door to localized demand/applications



CBRS Alliance Initial Commercial Launch
Event September 18, 2019

See <https://www.cbrsalliance.org/>

A few examples of connectivity solutions described on web site:

OnGo Private LTE Deployment Guide

The universe of mobile communications just became larger. With Federal Communications Commission authorization of Citizen...

Private LTE

OnGo Case Study: Aristotle Unified Communications

Aristotle Unified Communications uses OnGo solutions to provide cost-affordable, reliable connectivity to rural areas that...

Rural Connectivity

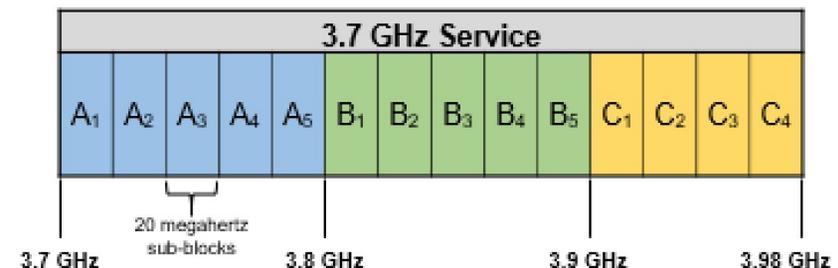
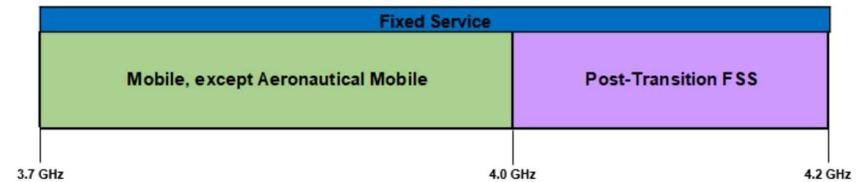
OnGo Case Study: Dallas Love Field Airport

Dallas Love Field Airport uses OnGo solutions to provide high-performance, low-latency connectivity to its customers,...

Deployment at an Airport

C-band Spectrum (3.7 – 4.2 GHz)

- Add mobile allocation to 3.7-4.0 GHz band.
- Transition 280 megahertz, plus a 20-megahertz guard band, from incumbent use to flexible-use through public auction.
- Require FSS operations to relocate to 4.0-4.2 GHz band.
- Provide incumbent FSS and FS licensees with reimbursement of reasonable relocation costs, paid by flexible-use licensees.
- Adopt service and technical rules for flexible-use licensees in the 280 megahertz of spectrum designated for transition to flexible-use.
- Bidding in auction 107 in on going (see AU Docket No. 20-25).



See <https://www.fcc.gov/document/fcc-expands-flexible-use-c-band-5g-0>

6 GHz Band

- **Rules Adopted April 23, 2020.**
- **Made 1200 megahertz of spectrum available for unlicensed devices:**
 - In the 5.925-6.425 GHz and 6.525-6.875 GHz bands, access points could transmit indoors and outdoors under control of an automated frequency coordination (AFC) system at power levels permitted in 5 GHz band.
 - In the 5.925-7.125 GHz band, access points could operate at lower power without an AFC system, restricted to indoor use only.
 - Client devices must be under the control of an access point.
- **FCC has also proposed to permit very low power operation (indoors and outdoors) across entire 6 GHz band**
 - Would operate at lower power than devices currently authorized under the 6 GHz unlicensed rules.
 - Uses are not restricted

High Band Spectrum Frontiers

Spectrum Allocations

- 12.55 GHz of Spectrum added for mobile
 - **Licensed Bands (Total 5.55 GHz):** 24.25-24.45 GHz and 24.75-25.25 GHz; 47.2-48.2 GHz; 27.5-28.35 GHz; 37-38.6 GHz; 38.6-40 GHz;
 - **Unlicensed Bands (Total 7 GHz):** 64-71 GHz

Service Rules

- Part 30: Upper Microwave Flexible Use Service (UMFUS)
- Geographic Area Licensing, Area Size, Band Plan, License Term, Overlay Auctions
- Technical rules
- Performance Requirements

Often Associated with “5G” – but 5G is not band specific

Expanding Access to Upper Reaches of the Spectrum

- **FCC Spectrum Horizons proceeding**
- **Expanded access above 95 GHz**
 - **Order adopted March 15, 2019**
 - **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
 - **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

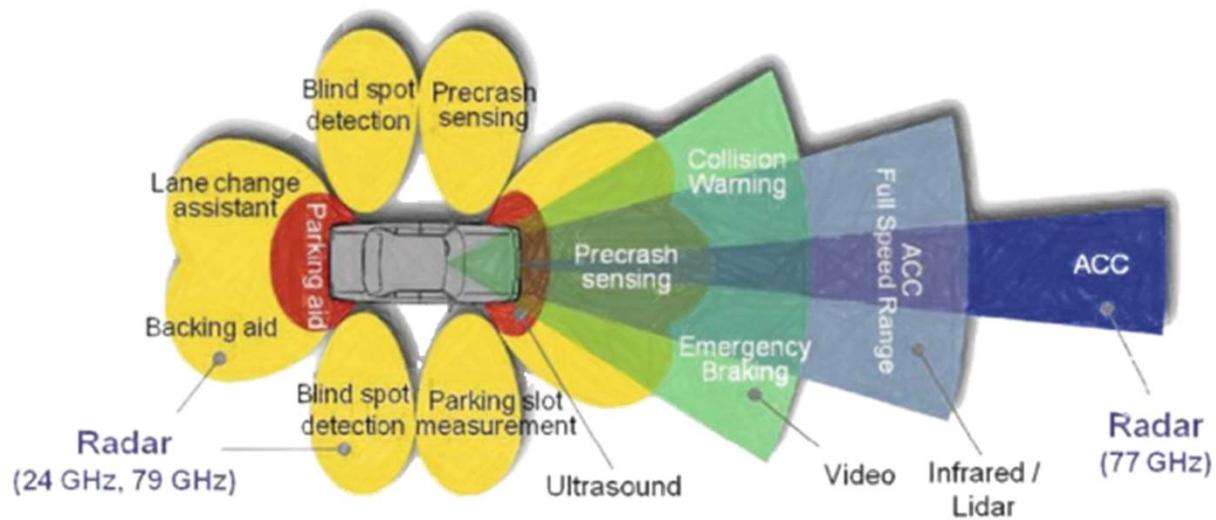
Innovation

See <https://www.fcc.gov/document/fcc-opens-spectrum-horizons-new-services-technologies-0>

Types of Radars/Sensors

- Traditional Radars (Radiolocation allocation is used)
 - Operates in high power (upward of megawatts)
 - Requires interference protection and coordination with other users
 - L-band, C-band and X/K-band have been popular
- Navigation/RadioNavigation
 - Vehicular Radars (76-81 GHz)
 - UAS Detect-and-Avoid Radars (24.45-24.65 GHz; 15.7-17.2 GHz has been proposed)
- Part 15
 - 60 GHz SRIMS
 - UWB
 - Above 95 GHz

Vehicular Radar and Field Disturbance Sensors



Highway Traffic Safety Administration Report DOT HS 812 632

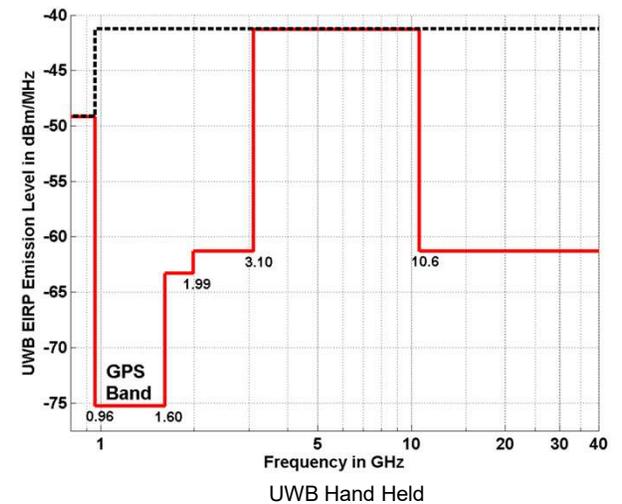
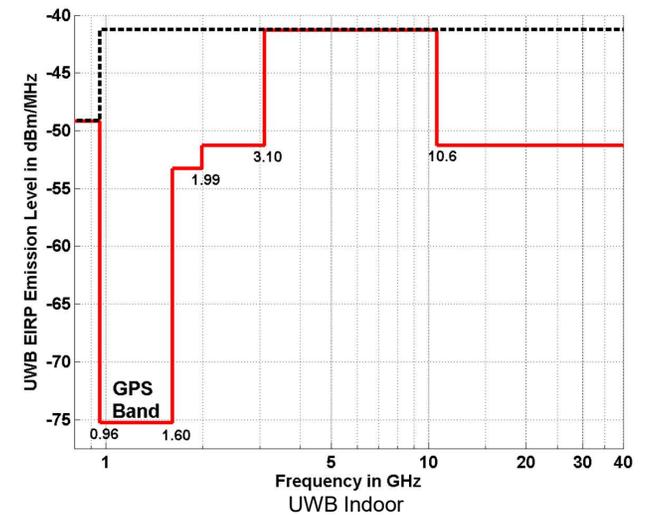
Vehicular Radar Bands and Rules

Radar/Sensor	Band	FCC Rule Section
LRR	76-81 GHz	Part 95, Subpart M
SRR	76-81 GHz	Part 95, Subpart M
NB Radar	24 GHz	Part 15.249
Ultrasonic	48 KHz	Part 18

- Certification of wideband vehicular radars designed to operate in the 23.12-29 GHz band under §15.252 and ultra-wideband vehicular radars designed to operate in the 22-29 GHz band under §15.515 shall not be permitted after September 20, 2018.

Ultra-Wideband

- UWB Rules (Part 15, Subpart F) identifies following systems.
- Ground-Penetrating and Wall Penetrating Radars. Must operate with a UWB below 10,600.
- Through-Wall Imaging Systems
 - Equipment operating with the UWB bandwidth below 960
 - Equipment operating with f_c and f_M between 1990 MHz and 10600 MHz
- Surveillance systems - The UWB bandwidth must be contained between 1,990 MHz and 10,600 MHz.
- Medical imaging systems - The UWB bandwidth must be contained between 3,100 MHz and 10,600 MHz.
- Indoor UWB Systems – These systems can not be used outdoor.
- Hand Held UWB Devices - Relatively small devices that are primarily hand held while being operated.



60 GHz Band

- In 2016 the Commission adopted rules for radars in the 60 GHz band. The short-range interactive motion-sensing (SRIMS) device allow users to interact via hand gestures with devices at short distance away without needing to touch the device itself.
- In 2018 FCC granted a request by Google for a wavier of section 15.255(c)(3) of the rules governing short-range interactive motion sensing devices.
- The Google Soli waiver allows the device to
 - operate in the 57-64 GHz band at a maximum +13 dBm EIRP, +10 dBm transmitter conducted output power, and +13 dBm/MHz power spectral density
 - operate on-board aircraft while not being part of a closed, exclusive on-board communication networks within the aircraft
 - operate with a maximum transmit duty cycle of 10 percent in any 33 milliseconds (ms) interval (i.e., the Soli sensor will not transmit longer than a total of 3.3 ms in any 33 ms time period)
 - comply with the prohibitions of use specified in 15.255(b)(2)(i) and (ii).

60 GHz Band Continue

- FCC has received a number of ME TOO waiver requests to permit devices to operate in the same spectrum, on the same duty cycle, and at same power level as Soli sensor. Applications include child left behind, seatbelt reminder, driver attention, and intruder detection.
- Technological Advisory Council Recommendation (see [TAC Sep. 20 Meeting](#))
 - Start a rulemaking proceeding to examine 60 GHz rules in 47 C.F.R. 15.255 to address issues raised by waiver requests for field disturbance systems.
 - Power levels for radar applications, including potential for equivalent power levels to communication systems for LBT radar.
 - Coexistence mechanisms, including duty cycle requirements, DFS, and contention-based protocols.

Part 15 Waivers

- A radio frequency device that operates in accordance with the Part 15 unlicensed rules may not be marketed unless it has completed the appropriate equipment authorization process - certification for most intentional radiators.
- Certification will only be granted for a device that has demonstrated compliance with all applicable Commission rules.
- If a specific rule cannot be complied with, the responsible party may submit a request for waiver.

Waiver Grants

- **Rohde & Schwarz (DA 20-1025)** Security scanner system in the 70-80 GHz band designed to detect the presence of concealed metallic and non-metallic threats carried in or underneath the clothing of persons. Requests waivers of Sections 15.205 (restricted bands) and 15.209 (field strength limits). Waiver granted Sep. 2020
- **Metrom (Open ET Docket 18-284)** requests waiver of the UWB rules for their AURA system designed to prevent collisions between trains, over-speed derailments, unauthorized train movement in work zones, and to minimize human error. (15.519(a), and 15.519(c)). Wavier granted Oct. 2020



Waiver Grants

- **Piper (Open ET Docket 19-246)** requests waiver of the UWB rules for their Enhanced Transit Location System (ETLS) designed to provide position information of trains, prevent train-to-train collisions and identifying unauthorized train movements in work zones (15.519(a)(2) and 15.250(c)-(d)). Waiver granted Nov. 2020
- **MIT (DA 20-445)** – WiTrack system passively monitors mobility, breathing, and other physiological signals in patients without body-worn sensors. Requests Waivers of Sections 15.503, 15.31, and 15.521 related to UWB operations and measurements. Waiver granted Apr. 2020
- **Sensible Medical Innovations, LTD (DA 19-937)** - ReDS System designed to measure lung fluid measurements in congestive heart failure patients. Required waivers of Sections 15.31, 15.503, 15.513, 15.521, and 15.525 related to bandwidth, frequency range, measurements and coordination. Waiver granted Sep. 2019

Thank You!