



Spectrum Sharing: Past, Present and Future

Ira Keltz, Deputy Chief
Office of Engineering and Technology
Federal Communications Commission
United States of America

Winnforum Online Three Day Deep Dive Event
September 22, 2020

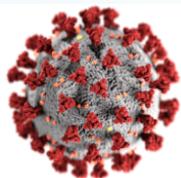
Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission



Some Perspective

Finite spectrum

Exponentially increasing demand



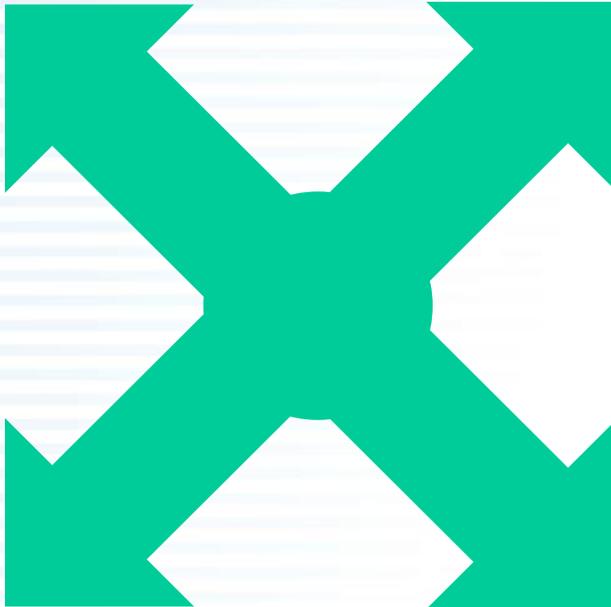
Increasing efficiency is key to meeting spectrum needs



Looking for New Spectrum: Choices and Trade-offs

Exclusive
Use

Unlicensed/
Shared Use



Incumbent
Rights/
Protection

New
Entrant
Flexibility



Sharing Is Hard: It Is Not In Our Nature

Toddler Rules of Sharing

1. If it's mine, it's mine! → Incumbents
2. If it's yours, it's mine! → New Entrants
3. If it's broken, it's yours! → Old "Junk Bands"



But, in kindergarten, we learned, "Share Everything" – Robert Fulghum



Spectrum Sharing Enablers

Finding Proper Incentives

Bi-directional Sharing

Predictability

Flexibility

Trust / Mutual Understanding

Enforcement Mechanisms

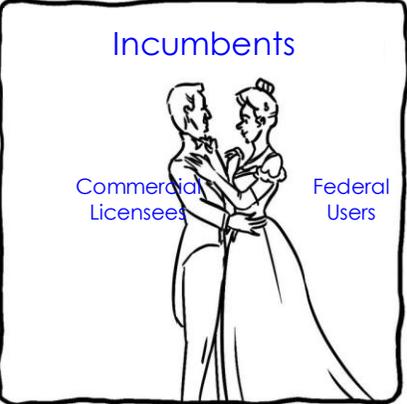


Abridged History of Spectrum Sharing

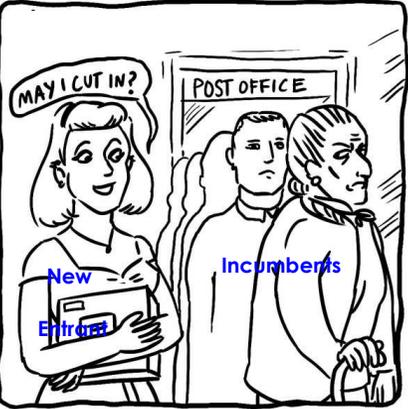
Service / Application	Spectrum Bands	BW (MHz)	Incumbents	New Users
Manual Coordination				
AWS-3	1695-1710; 1755-1780; 2155-2180	40	Fed/non-Fed	Licensed
Medical Body Area Networks	2360-2400	40	Fed/Non-Fed AMTS	Licensed by rule
Listen Before Talk				
Med Radio	401-406	5	Fed/Non-Fed	Licensed by rule
Dynamic Frequency Selection				
Medical Micropower Networks	413-419; 426-432; 438-444; 451-457	24	Fed/Non-Fed	Licensed by rule
U-NII (Wi-Fi)	5250-5350; 5470-5725	355	Fed/Non-Fed	Unlicensed
Low Power / Directional Beams				
60 GHz	57,000-71,000	14,000	Fed/Non-Fed	Unlicensed
Vehicular Radar	76,000-81,000	5,000	Fed/Non-Fed	Licensed by rule
Automatic Coordination / Dynamic Frequency Sharing				
CBRS	3550-3700	150	Fed/Non-Fed	Licensed/Licensed by rule
70/80/90 GHz	71,000-76,000; 81,000-86,000; 92,000-95,000	13,000	Fed/Non-Fed	Licensed/Unlicensed



The Spectrum Dance



Unlicensed	Federal Users	Commercial Licensees
Federal Users	Unlicensed	Commercial Licensees
Commercial Licensees	Satellite Service	Fixed Service
Commercial Licensees	Federal Users	Personal Services (Lic by rule)





A Short Hop Ahead

- 3450-3550 MHz Band
- August 10, 2020 White House/DoD Announcement
 - “... for the most part the spectrum will be available for commercial use without limits, while simultaneously minimizing impact to DoD operations.” - Dana Deasy, DoD CIO
- FCC NPRM (for vote at September 28 Open Meeting)
 - Cooperative Planning Areas
 - Periodic Use Areas

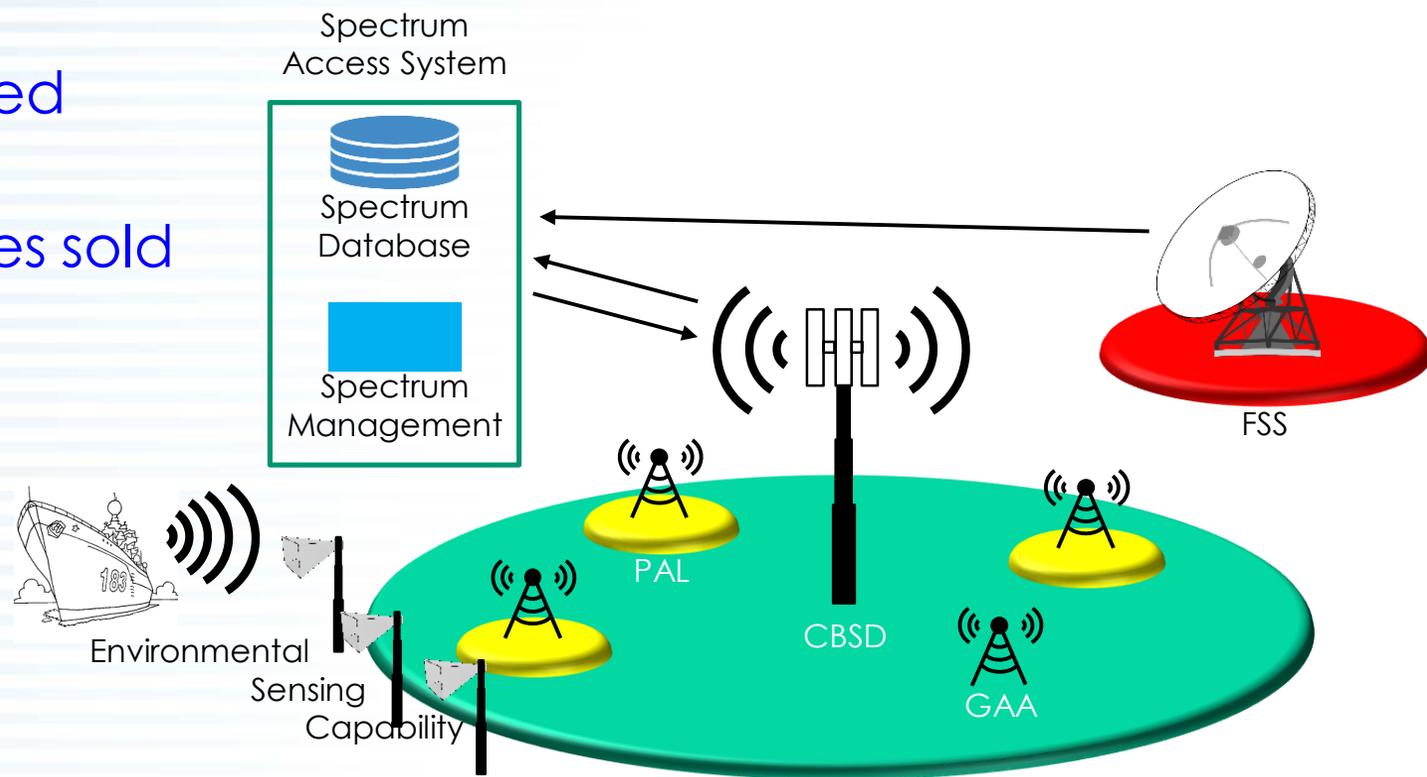


A Step To the Right and Back

- CBRS
 - Full commercial deployment since Jan. 27, 2020
 - Over 30,000 users
 - PAL auction concluded Aug. 25, 2020
 - Over 20,000 licenses sold for \$4.5B

And A Step Forward

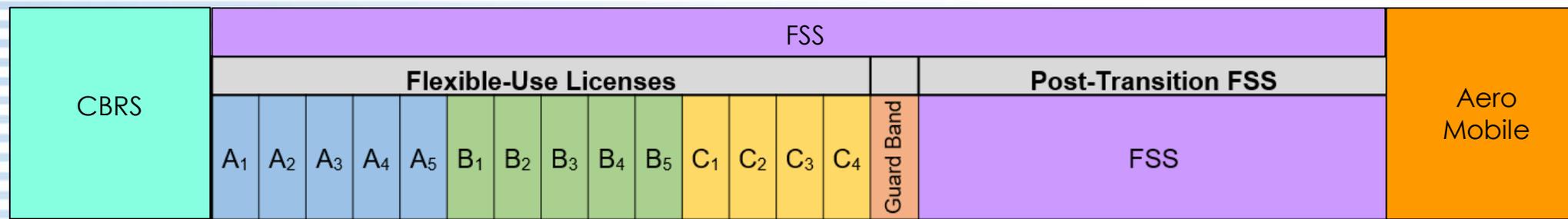
- PAL deployments expected soon after licensed are issued
 - Continued growth expected





A Step To the Right and Forward

3.7-4.2 GHz C-band repurposing



- 280-megahertz for terrestrial broadband networks
 - Satellite downlinks are protected through filters and technical rules
- Auction scheduled to begin December 8, 2020

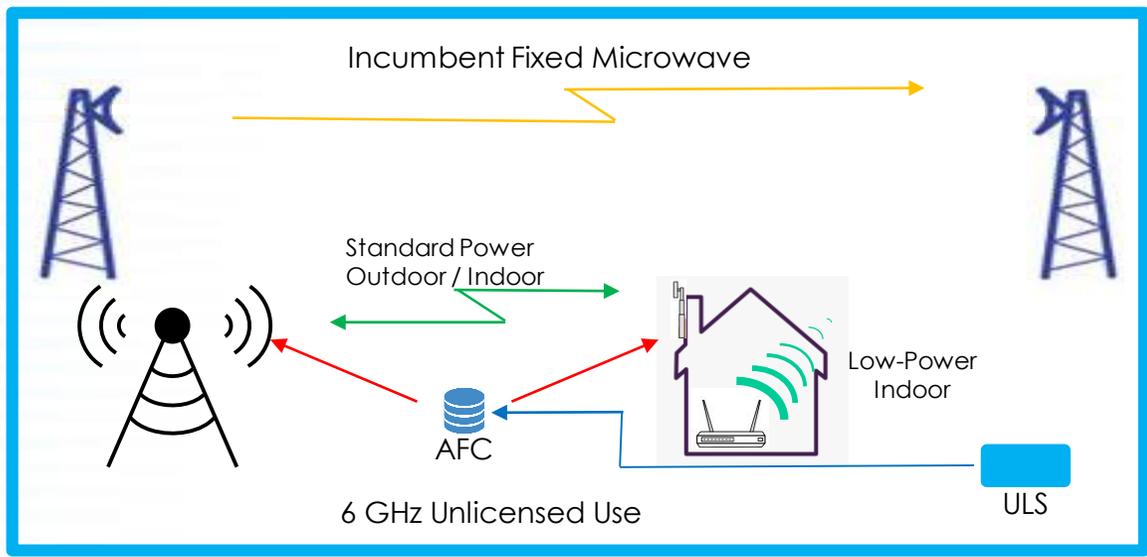
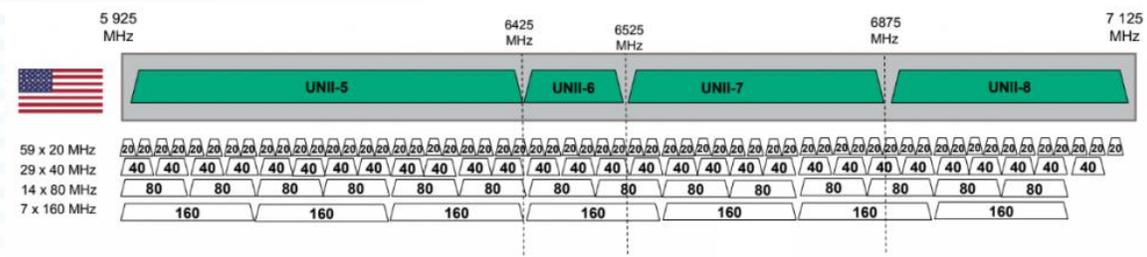
530-Megahertz of Licensed Mid-Band Spectrum To Be Available



Another Step To The Right

6 GHz unlicensed sharing with fixed microwave links

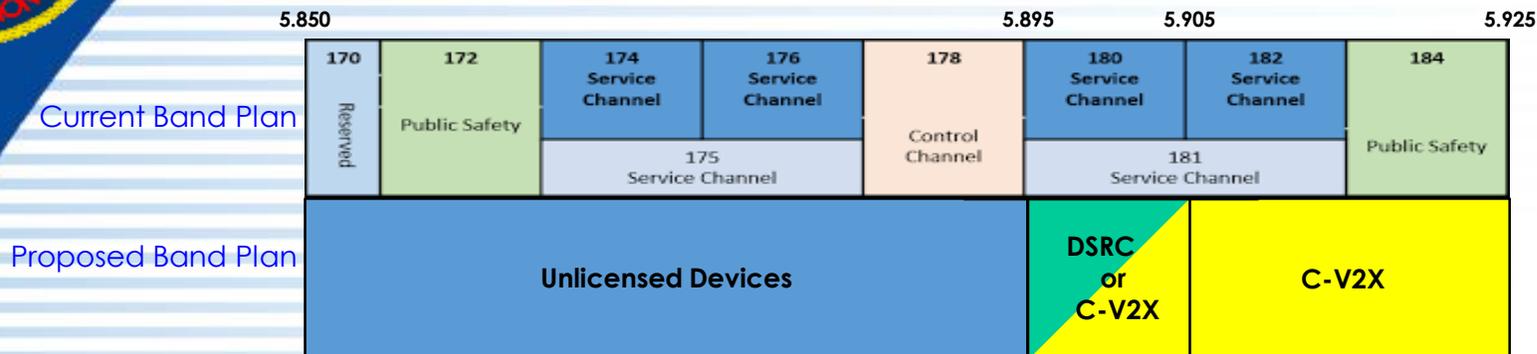
- Report & Order adopted April, 2020
- 1200 megahertz for unlicensed use in four sub-bands
 - Up to 7 160-megahertz wide channels
 - Standard access points in U-NII-5, 7 only
 - No usage on cars, trains, boats, aircraft
 - Low-power indoor access points across full band
 - Operation permitted on aircraft
 - Contention-based protocol required
- Further Notice of Proposed Rulemaking
 - Very low power use across full band
 - Virtual / augmented reality use cases
 - Additional power for low-power indoor
 - Mobile standard power
 - Higher power/antenna directivity for standard power



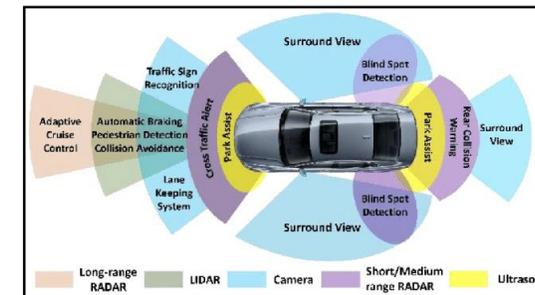


A Step To The Left And Forward

Unlicensed devices in 5.9 GHz



Sensors & Comm. Equipment on Cars Today



- Recognizes evolving and changed automotive and telecommunications landscape since 1999
 - “Fresh Look” at the band to provide maximum value to the American public
 - Recognizes continuing need for ITS applications - But many applications being delivered through other technologies
 - Provides opportunity to expand spectrum for broadband unlicensed devices
- Proposes dedicated spectrum for transportation/vehicle safety use while repurposing remaining spectrum for high throughput unlicensed broadband operations
- Seeks comment on best use of ITS spectrum
 - Newer C-V2X based on 3GPP standards
 - Existing DSRC standard – IEEE 802.11p – same family of standards as Wi-Fi, but not compatible with Wi-Fi
- Seeks to optimize spectrum for most efficient unlicensed use
 - Expands top of U-NII-3 band into new U-NII-4 band to provide an additional 160-megahertz channel for unlicensed use – not subject to DFS requirements
- Proposes to protect primary ITS allocation through technical rules (e.g., out-of-band emission limits)



Now Some Kicks Up and Down the Spectrum

- Commission is active on many spectrum proceedings
 - Millimeter Wave Bands – 24 GHz, 28 GHz, 37 GHz, 39 GHz
 - Regime for sharing lower 37 GHz still to be decided
 - 2.5 GHz
 - Report & Order, July 2019 provides flexibility and new opportunities to access the band
 - 70/80/90 GHz bands
 - Notice of Proposed Rulemaking, June, 2020 seeks more efficient use of the bands
 - Above 95 GHz
 - Rules effective September, 2020 expand use of bands above 95 GHz
 - 4.9 GHz
 - Report & Order and Further Notice of Proposed Rulemaking slated for vote at Sept. Commission meeting
 - Seeks to stimulate expanded use and investment through, among other things, novel spectrum leasing ideas
 - 900 MHz
 - Report & Order, May, 2020 realigns the band to repurpose narrowband channels to create a broadband channel



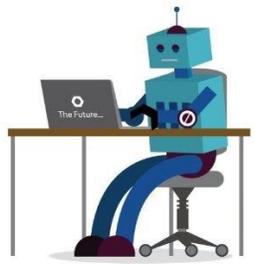
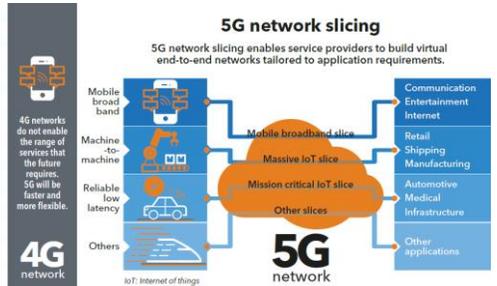
A Final Step To the Left and The Right

- DoD September 18, 2020, Request for Information
 - “DoD seeks information on innovative solutions and alternative approaches to enable DSS within the Department’s currently allocated spectrum with the goal of accelerating spectrum sharing decisions and 5G deployment.”
 - “While the Department has made available the 3450-3550 MHz spectrum band for 5G, are there new technologies or innovative methods as to how additional mid-band spectrum currently allocated to DoD can be made available for 5G faster?”
 - “What are other innovative ideas as to how 5G can share spectrum with high-powered airborne, ground-based and ship-based radar operations in the 3100-3550MHz spectrum band?”
 - “Are there other spectrum bands that can be made available to share quickly in the low and high band spectrum ranges?”
 - **And more!** (https://beta.sam.gov/opp/4851a65e2b2d4d73865a0e9865b0c28a/view?keywords=spectrum&sort=-modifiedDate&index=&is_active=true&page=1)

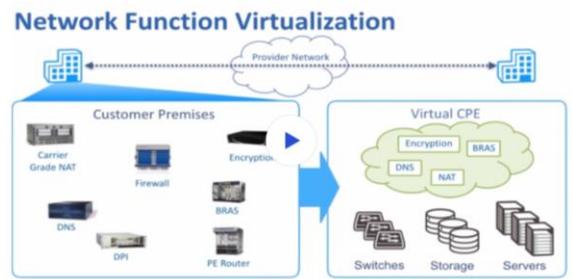


Future Of Spectrum Sharing

- Increasing demand and more congested spectrum requires:
 - Continued openness to new spectrum sharing opportunities
 - Building on recent successes (e.g., CBRS)
 - Leveraging new technology
 - 5G
 - Network slicing
 - Network function virtualization
 - Artificial intelligence
 - Machine learning



Artificial Intelligence & Machine Learning





The Dance Will Continue

Successful spectrum sharing relies on:

- Trust
- Enforcement mechanisms
- Reliability
- Predictability
- Incentives



Unlicensed	Federal Users	Commercial Licensees
Commercial Licensees	Satellite Service	Fixed Service
Commercial Licensees	Federal Users	Personal Services (Lic by rule)

We have a lot of recent spectrum sharing success to build upon to ensure the American public has choices and access to the services and applications it needs!



Thank You