What's Next for White Space

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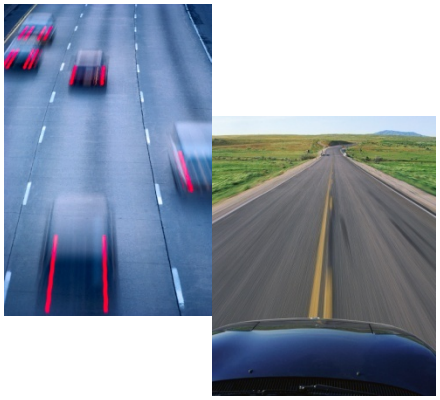
Note: The views expressed in this presentation are those of the author and may not necessarily represent the views of the Federal Communications Commission

Spectrum Management Today

Silo'd Allocations

Spectrum is Carved into Blocks with Each Radio Service Allocated Particular Blocks



Silos = Inefficient Use

Imagine if Lanes On the Highway Could Only be Used by Certain Vehicles

or

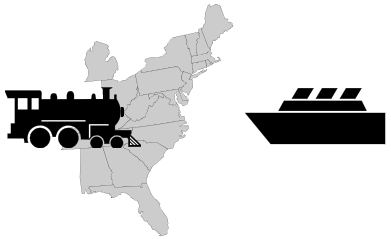
Air Routes Could Only be Used by Certain Planes

Spectrum Management Tools

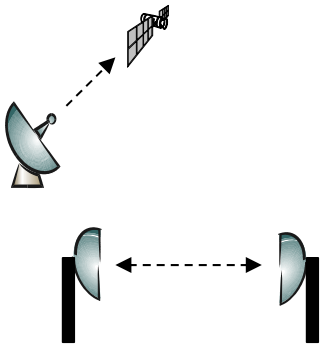
- Improve spectrum efficiency:
  - Compression – Same info w/ fewer “bits”
  - Technology advances: Smart antennas/MIMO
  - Secondary markets
- Reallocate spectrum:
  - Repurpose lightly used spectrum
  - Pay to relocate w/ comparable capability
- Sharing

Traditional Sharing Techniques

- Much of the Spectrum Is Shared
- Most Sharing is Static Based On
  - Geographic separation
  - Frequency coordination
  - Overlays
- Efficiency: Better, not Best
  - Leaves “White Space”
  - Unused Geographic Areas
  - Unused in Terms of Time



Re-use Frequencies Through Geographic Separation

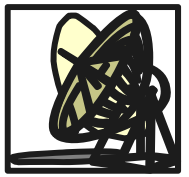


Earth Stations (Uplinks) and Fixed Microwave Links Use the Same Frequencies Through Antenna Discrimination

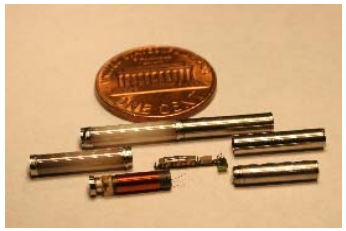
Advances in Sharing Techniques

- Industry Standards: Wi-Fi, Bluetooth
- Dynamic Frequency Selection

5 GHz unlicensed device detects radar and moves to an unoccupied channel



- Smart Medical Devices



Medical Micro-Power Networks &

Medical Body Area Networks

- Commercial Wireless: LTE & Small Cells

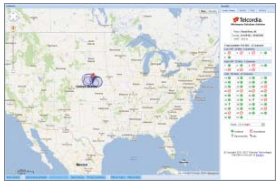
New Paradigm: White Space

- Basic Concept:
  - Identify unused spectrum – White Space
  - Device/Network adapts to use it – Dynamic Spectrum Access (DSA)
  - Technical standards protect services
- First Implementation: Provided for unlicensed operation in white space in TV bands based on data base access

Progress on White Space in the TV Bands

- Adopted final rules
- Approved the first devices
- Approved first data bases
- Approved initial deployments
- Rolled-out wireless microphone registration system
- System fully deployed on Eastern seaboard and soon the rest of the U.S.

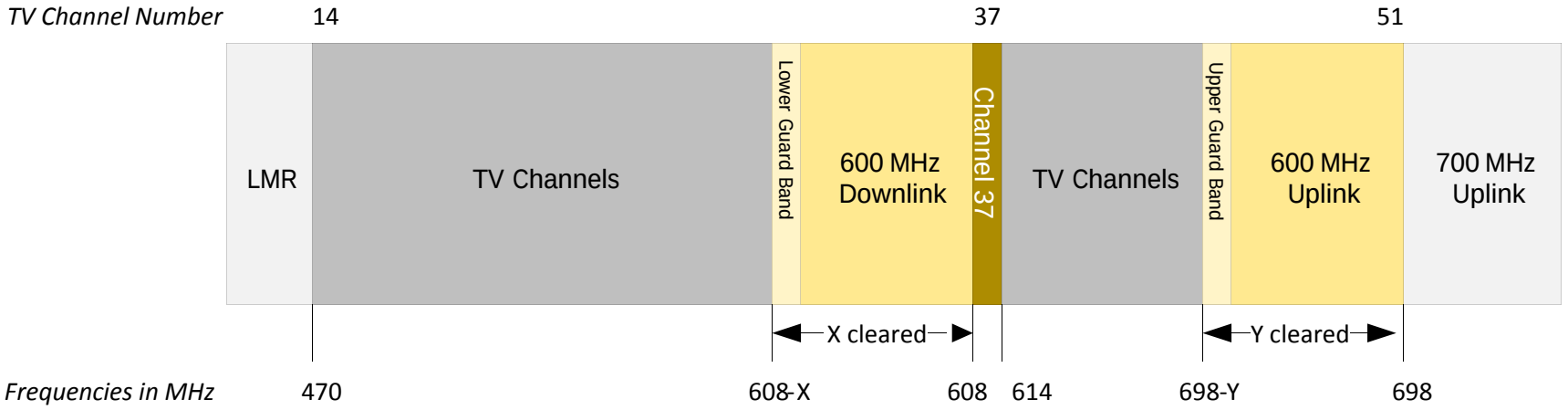
Meld KTS Adaptrum



Spectrum Bridge Telcordia

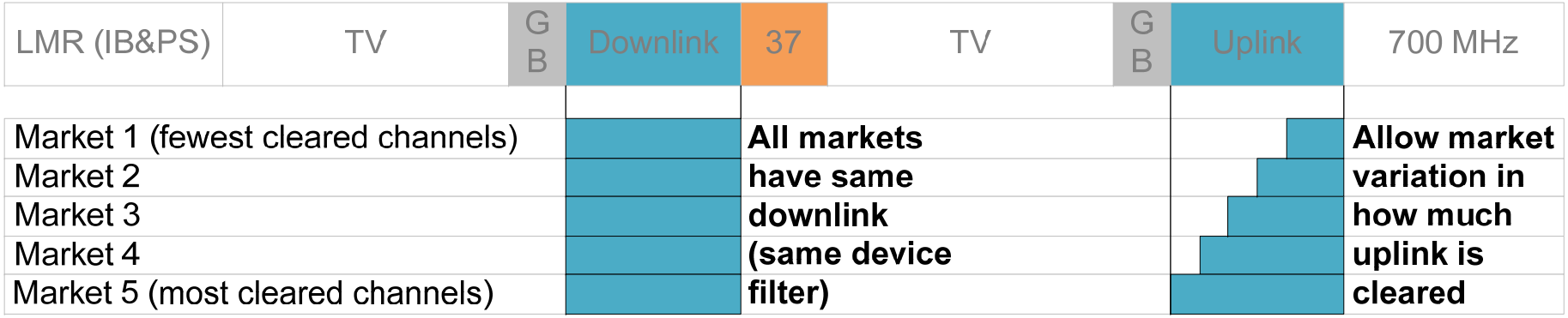
Wireless Cameras Cover Park in Wilmington NC

Incentive Auction Band Plan – Lead Proposal



- Amount of spectrum available is auction-dependent: "X cleared" (downlink) and "Y cleared" (uplink)
- Uplink located at ch. 51 (698 MHz) and expands downward
- Downlink located at ch. 36 (608 MHz) and expands downward
- 5 megahertz blocks proposed, paired wherever possible
- 6 megahertz guard bands proposed, available for unlicensed use

Plan Allows for Non-Nationwide Clearing of Spectrum



- Proposes fixed amount of downlink spectrum nationwide to allow for the same receiver filters in all devices, reducing cost and promoting interoperability
- Allows for variation in amount of uplink spectrum to accommodate different quantities of cleared spectrum in different geographic areas
- Gives greater flexibility than other band plans that require clearing of uniform amount of spectrum nationwide

Proposals for Unlicensed

NPRM proposals would provide a substantial amount of unlicensed spectrum, much available on a nationwide basis

Specifics:

- Continue to allow unlicensed operation on unused channels in the repacked television broadcast bands (white spaces)
- Remove reservation of two channels for wireless microphones, making more available for white space devices
- Allow unlicensed use of two guard bands of 6 MHz each
- Allow unlicensed use in channel 37, with exclusion zones to protect radio astronomy and wireless medical telemetry

Sharing White Space in Other Spectrum

- FCC Notice of Inquiry (NOI) asked how dynamic access can provide more intensive and efficient use of spectrum

- President's Council Of Advisors on Science and Technology (PCAST) Issued Report in August 2012: *Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth*
  - Recommended building upon the white space model for access to federal spectrum, particularly in the band 2700 – 3700 MHz
  - Can apply model for both licensed services and unlicensed devices

- Actions:
  - NTIA identified 3550 – 3650 MHz for wireless broadband services
  - Specified exclusion zones along coasts based on potential interference with Navy radars
  - NPRM adopted Dec. 12, 2012 builds on PCAST report and advanced sharing techniques

Figure 4-8. Terrain Dependent Exclusion Zone Distances for Shipborne Radar – 1

3.5 GHz NPRM (GN Docket No. 12-354)

- Provide for small cells and other uses through data base access / dynamic spectrum access - - reduce exclusion zones
- Envisions three tiers of users, each with different rights and protections:
  - **First tier, Incumbent Access,** would include authorized federal users and grandfathered fixed satellite service licensees. Would be afforded protection from all other users in the 3.5 GHz Band.
  - **Second tier, Protected Access,** would include critical use facilities, such as hospitals, utilities, government facilities, and public safety entities that would be afforded quality-assured access to a portion of the 3.5 GHz Band in certain designated locations.
  - **The third tier, General Authorized Access,** would include all other users – including the general public – that would have the ability to operate in the 3.5 GHz Band subject to protections for Incumbent Access and Protected Access users.
- A spectrum access system, incorporating a geo-location enabled dynamic database, would govern access to the 3.5 GHz Band
- Supplemental proposal would include 3650 – 3700 MHz

4.9 GHz NPRM (WP Docket No. 07-100)

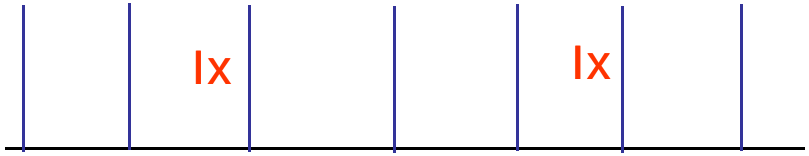
- Workshop early last year: 4.9 GHz (4940 – 4990 MH) public safety spectrum is not heavily occupied
- NPRM invited comment on various approaches to increase use
- Specifically asked about sharing based on registration and data base access

Sharing at 1755 – 1850 MHz

- NTIA released report on potential for reallocation of federal spectrum at 1755 – 1850 MHz for wireless broadband
- Challenges - - cost, complexity, time
- Strong support for increased sharing
- NTIA convened work groups under Commerce Spectrum Management Advisory Committee
- FCC is participating in work groups
- T-Mobile granted experimental license on behalf of industry to perform sharing tests
- CSMAC meeting: January 17, 2013

Federal Incumbent Systems:

- Fixed Point-to Point Microwave
- Military Tactical Radio relay
- Air Combat Training System
- Precision Guided Munitions
- Tracking, Telemetry & Commanding
- Aeronautical Mobile Telemetry
- Video Surveillance
- Unmanned Aerial Systems
- Other Systems



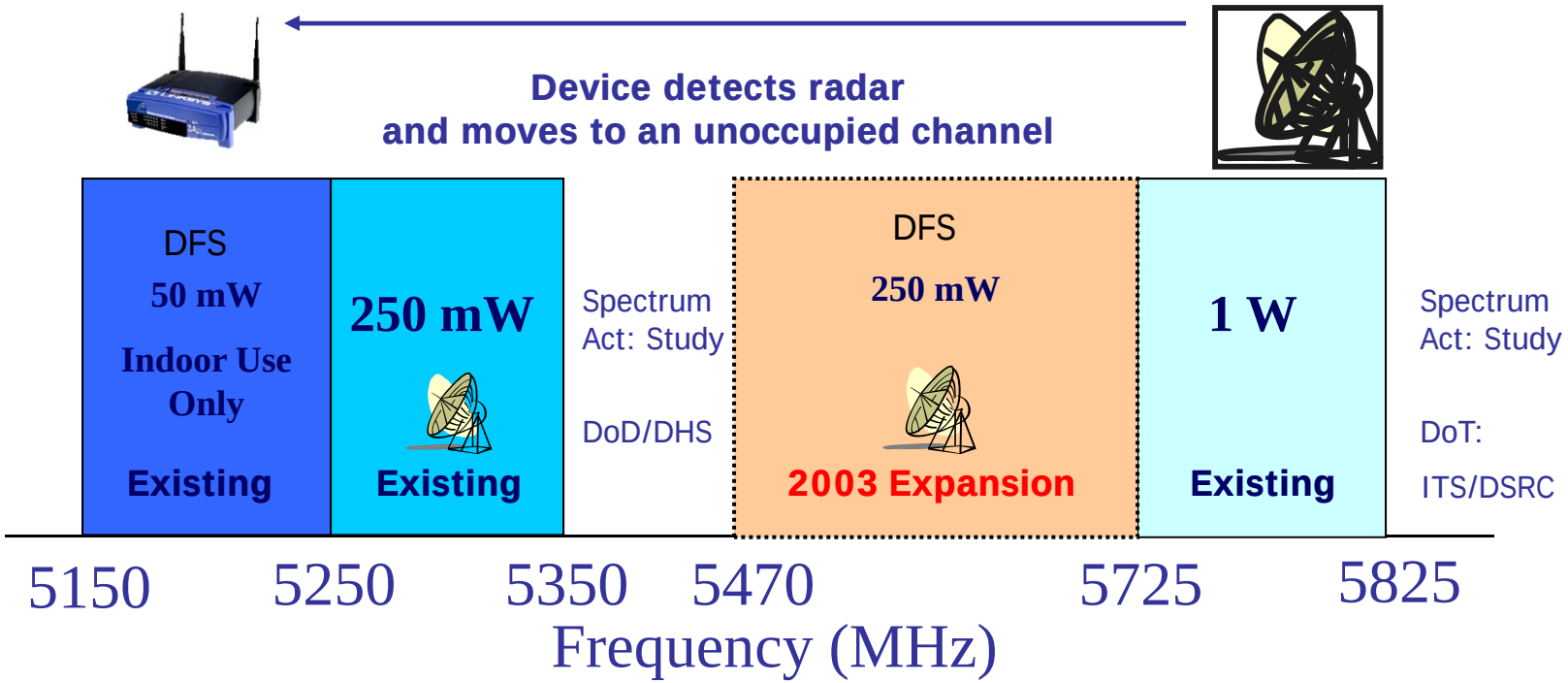
In LTE data is divided among multiple “carriers” – OK if some lost

Unlicensed Spectrum Expansion at 5 GHz

- Middle Class Tax Relief and Job Creation Act Section 6406:
  - NTIA study of 2 blocks of additional spectrum for unlicensed at 5 GHz
  - NTIA Study on Lower 5 GHz – NTIA must report to Congress on possible unlicensed operations in 5350-5470 MHz band
  - NTIA Study on Upper 5 GHz – NTIA must report to Congress on possible unlicensed operations in the 5850-5925 MHz band
  - FCC 5 GHz Proceeding – FCC must begin a proceeding to examine unlicensed operations between 5350-5470 MHz
  - FCC final action predicated upon finding that sharing can occur without causing harmful interference to federal systems

Spectrum Expansion at 5 GHz

- **Existing sharing based on Dynamic Frequency Selection (DFS)**
- **Devices "listen" and perform processing to detect radars**
- **NTIA Studies: Is sharing feasible in expansion bands**
- **Related to IEEE 802.11ac standard under development**



Experimental Licensing Notice of Proposed Rule Making (ET Docket No. 10-236)

- Notice of Proposed Rule Making (NPRM) seeks to promote research and development of new radio technologies, devices, and applications.
- Proposed to create a new type of Program License, which would give qualified entities broad authority to conduct a program of research without the need for approval of each experiment.
- Proposed three types of Program Licenses:
  - **Research license** would allow universities, laboratories, and other qualified research institutions to conduct experiments over a wide variety of frequencies and other operating parameters, without the need for individual authorization or reauthorization for each individual experiment.
  - **Geographic "innovation zones"** – generally relatively remote locations - where researchers could conduct a wide range of experiments under certain general conditions.
  - **Medical institutions** to innovate and develop new devices that can save lives, have a significant impact on reducing medical costs, and provide new treatment options for our wounded service men and women.
- Proposed ways to streamline and clarify the existing rules such as expanding opportunities for researchers and manufacturers to conduct market trials

Equipment Authorization: Planned Rule Makings

- First NPRM – Telecommunications Certification Body Obligations:

  Consider:

  - Refine & codify PBA procedure
  - Clarify TCB obligations for post-grant checks
  - Require accreditation for all test labs
  - Recognize latest industry testing standards

- 2nd NPRM – Administrative Procedures:

  Consider:

  - Merge different self-approval procedures
  - Modify permissive change and Software Defined Radio rules
  - Certify modular transmitters for licensed services

Conclusion

- Busy year ahead
- Continue to build upon white space model
- Encourage involvement from this community