

# ISART Panel: Sharing Radar Bands with Commercial Systems: An Overview of Sharing Concepts



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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

# Mobile Demand Is Creating a Spectrum Crunch

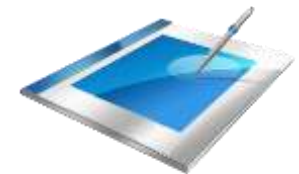
- 300 million mobile subscribers in the U.S., and 90% of us keep our mobile device within arms length 24 hours a day
- Smartphone sales have eclipsed PC sales
- Mobile broadband is being adopted faster than any computing platform in history
- A typical smartphone places 24 times as much demand on spectrum as an old feature phone
- Tablets demand 120 times as much
- Multiple experts expect that mobile demand for spectrum will increase more than 35x in the next few years (3,500%)



24/  
7



24X



120X

# Mobile Will Create New Businesses, New Jobs, and New Benefits

- **Ability to send or receive video anywhere, any time:**
  - Video conferencing
  - Check on an elderly parent living alone
  - 18 million college students - - see them every weekend
- **Consult with mechanic when car breaks down**
- **After accident - video link with a doctor**
- **School buses can become rolling study halls**
- **Farmers in their fields can track weather or commodity prices in real time**
- **Plumbers or electricians can consult in real time with colleagues, or download video tips**
- **TIA: \$860 billion in productivity gains for U.S. businesses by 2016**





# FCC Response to the Spectrum Crunch

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- FCC National Broadband Plan (NBP) – March 2010
- Comprehensive plan for spectrum policy reform
- FCC took numerous actions over the past year:
  - Opened 25 MHz of WCS spectrum for mobile broadband
  - Flexibility for terrestrial deployment in the mobile satellite service
  - Proposed increased efficiency for backhaul spectrum
  - Finalized rules for TV white space
  - Proposed to revamp experimental licensing
  - Began inquiry on dynamic spectrum access
  - Issued proposal to repurpose portion of TV spectrum
- NTIA report identified 15 megahertz for reallocation to broadband and 100 megahertz for sharing



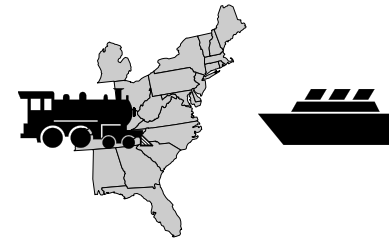
# NTIA-FCC Activities

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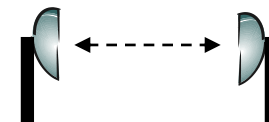
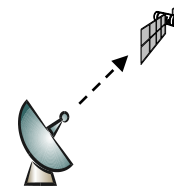
- Presidential Memo issued on June 28, 2010 on unleashing the wireless broadband revolution
- NTIA to collaborate with the FCC to make available a total of 500 MHz of Federal and nonfederal spectrum over the next 10 years:
  - Suitable for both mobile and fixed wireless broadband use
  - Available to be licensed by the FCC for exclusive use or made available for shared access by commercial and Government users in order to enable licensed or unlicensed wireless broadband technologies to be deployed
- NTIA released spectrum reports in November 2010
  - Fast-track bands – 1695 – 1710 MHz; 3550 – 3650 MHz
  - Plan to Identify 500 MHz of spectrum
- FCC Spectrum Task Force issued public notice on March 8, 2011 inviting comment on frequency bands identified by NTIA
- NTIA Policy & Planning Steering Group focusing on 1755 – 1850 MHz; analysis expected by end of September

# Traditional Ways of Finding Spectrum for New Services

- Improve efficiency – pack more service in same space
  - Technical rules
  - Secondary markets
- Sharing:
  - Geographic separation
  - Frequency coordination
  - Overlays
  - Time of use
- Reallocation:
  - Remove or reduce allocation w/ no compensation
  - Reallocate and new licensee pays for relocation
  - Reallocate & pay for relocation w/ auction proceeds



Re-use Frequencies Through Geographic Separation



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

## Examples of Sharing

Q: Why to Consider Sharing with Radars? A:They Operate in Much of the Spectrum.

U.S. Radar Operating Bands, Radio Services, and Allocation Status

Frequency Band (MHz)	Radiolocation	Radionavigation	Aeronautical Radionavigation	Maritime Radionavigation	Meteorological Aids	Earth Exploration-Satellite
216-225 <sup>1</sup>	Sec					
420-450	Pri					
890-902	NiB					
902-928	Pri					
928-942	NiB					
1215-1240 <sup>2</sup>	Pri					Pri Pri
1240-1300 <sup>2</sup>	Pri		Pri Pri			Pri Pri
1300-1350	Sec					
1350-1370	Pri		Pri Pri			
1370-1390	Pri					
2310-2320	Sec	Pri				
2320-2345	Pri	Pri				
2345-2360	Sec	Pri				
2360-2390 <sup>3</sup>	Pri					
2390-2417	NiB					
2417-2450	Sec					
2450-2483.5	Sec	Sec				
2483.5-2500	Sec					
2700-2900	Sec		Pri Pri		Pri	
2900-3000	Sec			Pri Pri	Pri	
3000-3100	Sec			Pri Pri		
3100-3300 <sup>2</sup>	Pri	Sec				Sec Sec
3300-3500	Pri	Sec				
3500-3650 <sup>4</sup>	Pri	Sec	Pri			
4200-4400			Pri Pri			
5250-5350 <sup>2</sup>	Pri	Sec				Pri Pri
5350-5460 <sup>2</sup>	Pri	Sec	Pri Pri			Pri Pri
5460-5470	Sec	Sec	Pri Pri			
5470-5600	Sec	Sec		Pri Pri		
5600-5650	Sec	Sec		Pri Pri	Pri Pri	
5650-5925	Pri					
8500-8550	Pri	Sec				
8550-8650 <sup>1</sup>	Pri	Sec				Pri Pri
8650-8750	Pri	Sec				
8750-8850	Pri	Sec	Sec Sec			
8850-9000	Pri	Sec				
9000-9200	Sec	Sec	Pri Pri			

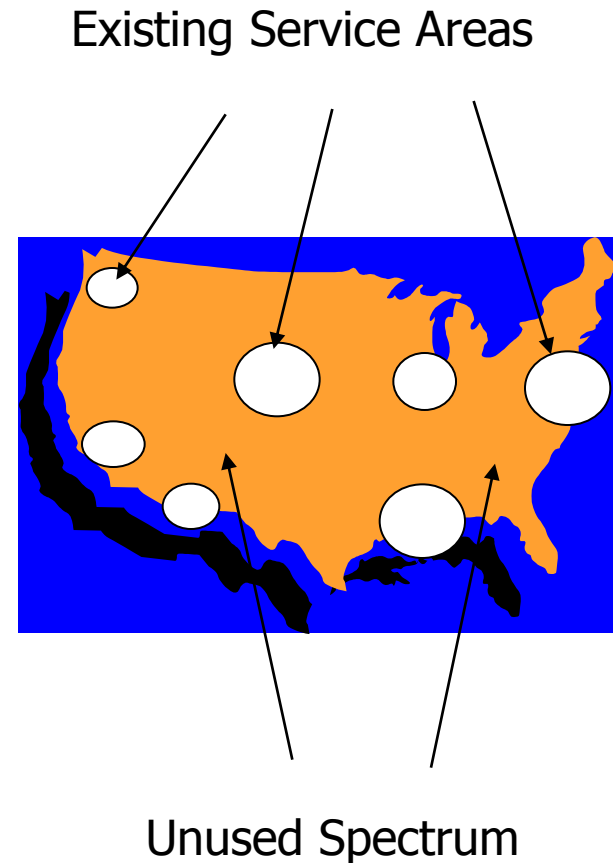
U.S. Radar Operating Bands, Radio Services, and Allocation Status

Frequency Band (MHz)	Radiolocation	Radionavigation	Aeronautical Radionavigation	Maritime Radionavigation	Meteorological Aids	Earth Exploration-Satellite
9200-9300	Sec	Sec				
9300-9500	Sec	Sec	Pri Pri		Sec Sec	
9500-9800 <sup>2</sup>	Pri	Sec				Pri Pri
9800-9975	Pri	Sec				
9975-10025	Pri	Sec				Sec Sec
10025-10500	Pri	Sec				
10500-10550	Pri	Pri				
13250-13400 <sup>2</sup>			Pri Pri			Pri Pri
13400-13750 <sup>1</sup>	Pri	Sec				Pri Pri
13750-14000	Pri	Sec				
14000-14200			Pri Pri			
15400-15700			Pri Pri			
15700-17200	Pri	Sec				
17200-17300 <sup>2</sup>	Pri	Sec				Pri Pri
17300-17700	Sec					
24050-24250	Pri	Sec				Sec Sec
24250-24450				Pri		
24450-24650			Pri Pri			
24750-25050			Pri Pri			
25060-25250			Pri			
31800-33400			Pri Pri			
33400-35500	Pri	Sec				
35500-36000 <sup>2</sup>	Pri	Sec				Pri Pri
59000-64000	Pri	Pri				
66000-71000			Pri Pri			
76000-77000	Pri	Pri				
77000-78000	Pri	Pri				
78000-79000	Pri	Pri				Pri Pri
79000-81000	Pri	Pri				
82000-94000	Pri	Pri				
94000-94100 <sup>2</sup>	Pri	Pri				Pri Pri
94100-95000	Pri	Pri				
95000-100000	Sec		Pri Pri			
126000-134000	Pri	Pri				
134000-142000	Sec	Sec	Pri Pri			
144000-149000	Pri	Pri				
190000-200000			Pri Pri			

Source: Department of Commerce Report May 2000 - Federal Radar Spectrum Requirements

# An Emerging Sharing Technique: Opportunistic Use of Spectrum

- Finding 500 MHz will not be easy
- Reallocation not always feasible
- Opportunistic use of spectrum can play a significant role in meeting spectrum demand
- Some services only operate in certain areas
- Some services may not operate continuously
- Creates opportunity to operate outside the existing service areas or dynamically with time







# Experiences Thus Far With Advanced Radio Technology

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- Commercial wireless systems use “sensing” to measure signal levels for hand-offs
- Unlicensed PCS
- Med Radio rules
- Unlicensed technologies – Wi-Fi
- FCC SDR rule makings – 2001 & 2005
- U-NII rules - DFS
- 3650 MHz – Restricted/Unrestricted bands
- Spectrum test bed

# Dynamic Spectrum Access NoI

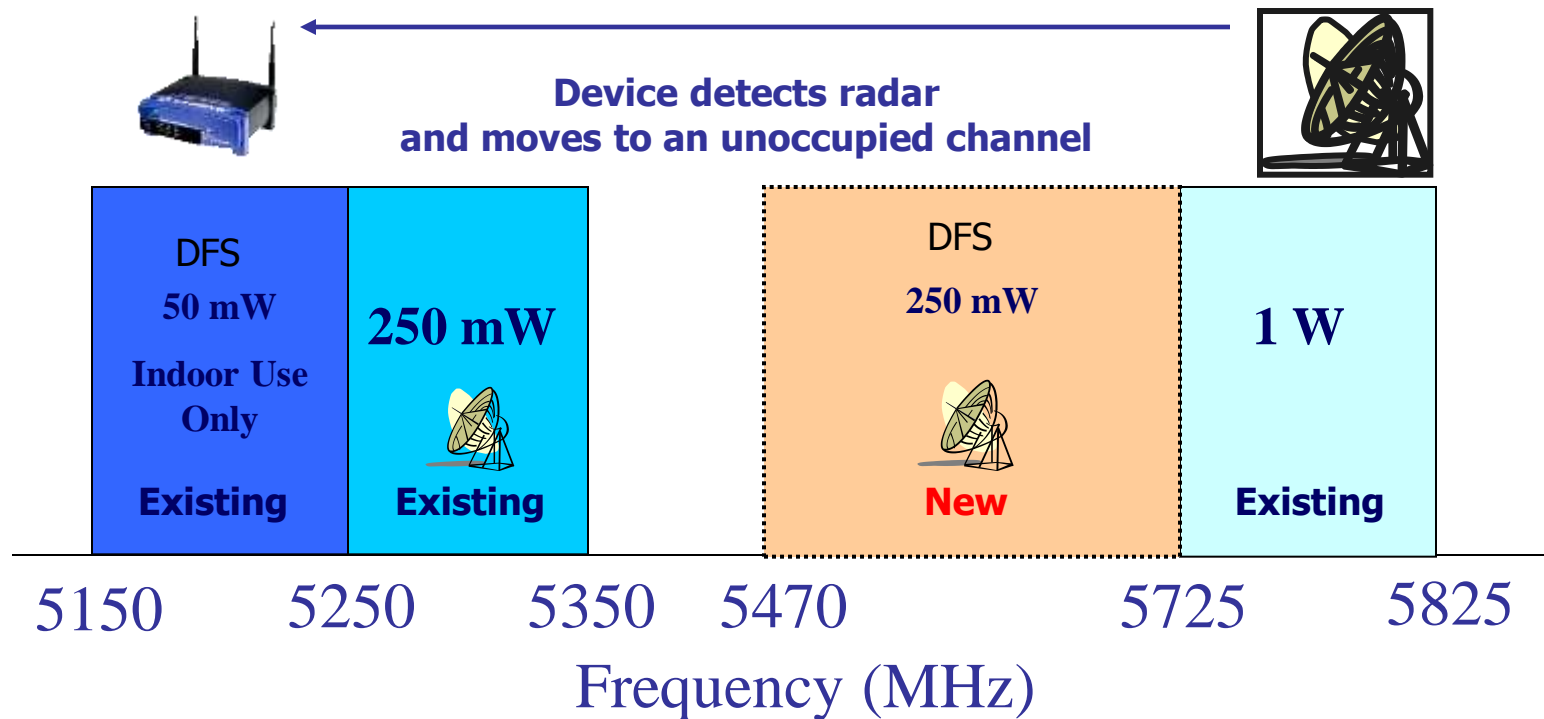


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- Notice of Inquiry (NOI) considers how dynamic access radios and techniques can provide a more intensive and efficient use of spectrum
- Seeks comment on the current state of the art and how FCC can promote these technologies - - test-beds or modifying its spectrum management practices and policies
- Covers both licensed services and unlicensed devices
- What spectrum bands would be most suitable?
- Asks whether TV White Space model might be used for other bands
- Asks whether and how to incorporate spectrum sensing for other bands
- Asks whether FCC provisions for secondary market arrangements could be enhanced to increase use by dynamic access radios
- Asks how to improve FCC "Spectrum Dashboard" for DSA

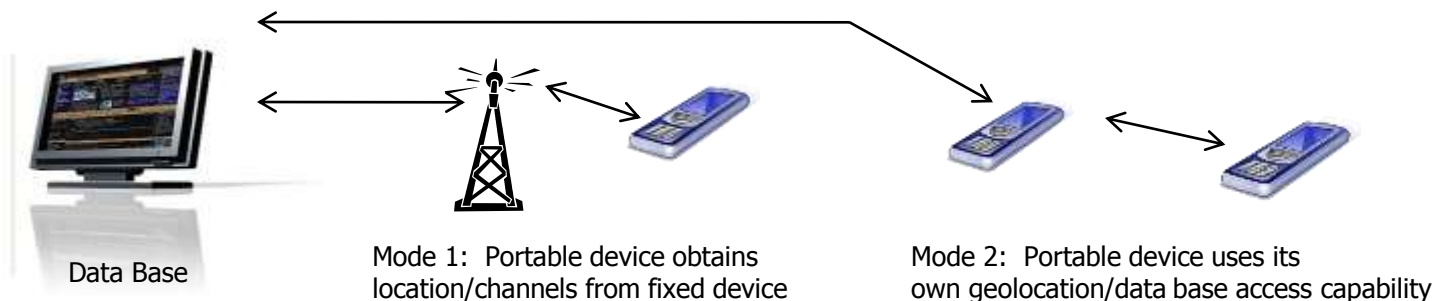
# Sharing with Radars at 5 GHz

- Sharing based on Dynamic Frequency Selection (DFS)
- Devices “listen” and perform processing to detect radars



# TV White Spaces

- Initial focus was on spectrum sensing
- Final rules:
  - Option 1 – Access determined by device geolocation & access to data base of protected services
  - Option 2 – Spectrum sensing w/ rigorous review & authorization process
- Services protected in the data base:
  - TV digital and analog Class A, low power, translator & booster stations
  - Broadcast auxiliary (wireless mikes)
  - Cable head-ends and TV translators
  - Land mobile
  - Sites with significant wireless microphone use



## Considerations for (Licensed) Sharing with Federal Radars at 3550 – 3650 MHz As per NTIA Fast-Track Report



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

Source: NTIA Report Nov. 2010 – *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675 – 1710 MHz, 1755-1850 MHz, 3500-3650 MHz, 4200-4240 MHz and 4380-4400 MHz Bands*



# Panel Participants

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- 8:00 – 8:15 Panel Introduction and Overview (Julius Knapp)
- 8:15 – 8:23 Robert Matheson – Cost/Benefits in sharing radar bands?
- 8:23 – 8:31 Jack Unger – WISPA’s perspective on radar bandsharing at 5 GHz and 3.4 GHz
- 8:31 – 8:39 Clem Fischer – A business model for outdoor mobile broadband in radar bands
- 8:39 – 8:47 Jon Peha – Opportunistic Primary-Secondary Spectrum Sharing with a Rotating Radar
- 8:47 – 8:55 Rohan Murty – Transferring TV Whitespace Sharing Concepts to Radar
- 8:55 – 9:03 Glen Griffith – Medical Devices coexisting with radar in 420-450 MHz band
- 9:03 – 9:11 Mark McHenry – Incumbent’s DSA Requirements
- 9:11 – 9:45 Moderated Panel Discussion
- 9:45 – 10:00 Audience Q&A