

# Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth

President's Council of Advisors on Science and  
Technology (PCAST)

Oct 19, 2012

# Key PCAST Members and Spectrum Experts

## PCAST Members

- **Mark Gorenberg** (chair), Hummer Winblad Venture Partners
- **S. James Gates, Jr.**, University of Maryland, College Park
- **Craig Mundie**, Microsoft Corporation
- **William Press**, University of Texas at Austin
- **Maxine Savitz**, National Academy of Engineering
- **Eric Schmidt**, Google, Inc.

## Invited Experts

- **Yochai Benkler**, Harvard University
- **Jennifer Bernhard**, University of Illinois at Urbana-Champaign
- **Vanu Bose**, Vanu Inc.
- **Michael Calabrese**, New America Foundation
- **Dale Hatfield**, University of Colorado, Boulder
- **Michael Katz**, University of California, Berkeley
- **Paul Kolodzy**, Kolodzy Consulting
- **William Lehr**, Massachusetts Institute of Technology
- **Jon Levin**, Stanford University
- **David Liddle**, U.S. Venture Partners
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- **J.D. McCreary**, Georgia Tech Research Institute
- **Mark McHenry**, Shared Spectrum
- **Milo Medin**, Google, Inc.
- **Teresa Meng**, Stanford University
- **Jeff Reed**, Virginia Tech
- **Dennis Roberson**, Illinois Institute of Technology
- **Gregory Rosston**, Stanford University
- **Pierre de Vries**, University of Colorado, Boulder
- **Kathleen Wallman**, Wallman Consulting, LLC.
- **Tom Wheeler**, Core Capital

## Staff

- **Deborah Stine** (executive director), PCAST
- **Thomas Power**, Office of Science and Technology Policy
- **Danielle Evers**, AAAS S&T Policy Fellow
- **David Lindley**, Writer

## Federal Agency Liasons

- **John Leibovitz**, Federal Communications Commission
- **Douglas Sicker**, National Telecommunications and Information Association

# Why Do We Need to Repurpose Spectrum?

- **Presidential Memorandum of June 2010 requires 500 MHz of spectrum to be made available for commercial use within 10 years**
- **Huge WW Mobile Device Growth Opportunity (2020)**
  - \$4.5T Global Value
  - M2M Wave next
  - 50B devices
  - Zetta-bytes of Data
- **Enhanced Mobile Devices are Already Leading to a US Bandwidth Deficit**
  - Data more than doubled 4 years in a row
  - Smartphones generate 24X data of basic-feature cell phones
  - Tablets create 5X more traffic than smartphones
- **Federal Agencies also need more Spectrum**
  - DOD unmanned aerial systems increased 45X in 8 years

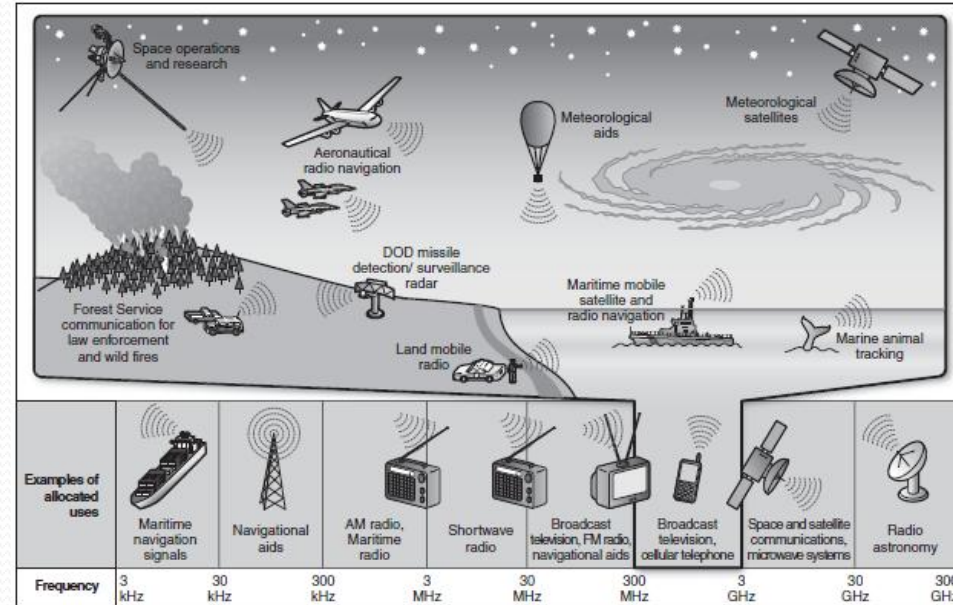
The screenshot shows the White House website interface. At the top, it says 'the WHITE HOUSE PRESIDENT BARACK OBAMA' and 'the ADMINISTRATION'. Below that are navigation links: 'BLOG', 'PHOTOS & VIDEO', 'BRIEFING ROOM', 'ISSUES'. The main content area is titled 'Home • Presidential Memorandum: Unleashing the Wireless Broadband Revolution'. It includes the White House logo, the Office of the Press Secretary, and social media sharing options (E-Mail, Tweet, Share). The memorandum is dated 'June 28, 2010' and is for 'Immediate Release'. The subject is 'Unleashing the Wireless Broadband Revolution'. The text of the memorandum discusses the importance of wireless broadband for America's future competitiveness and global technology leadership.

## WIRELESS DATA GROWTH LEADS TO SPECTRUM DEFICIT

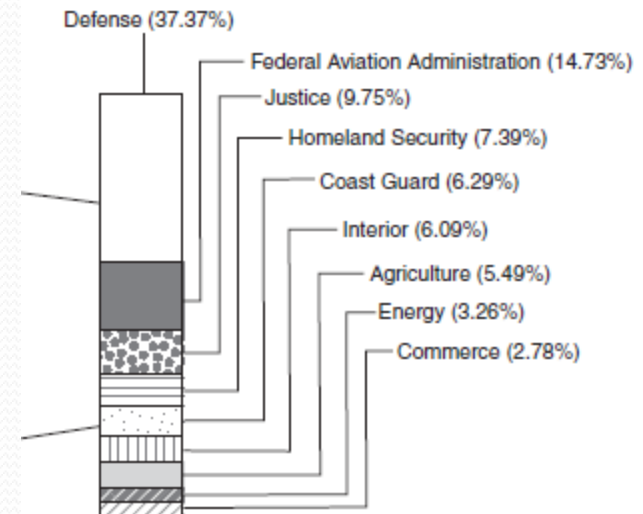


# PCAST Study Concentrated on Federal Spectrum

- Clearing and Reallocation of Federal Spectrum is Not Sustainable.**
  - Recent NTIA Study - Clearing of just one 95 MHz band will take 10 years, **cost \$18 billion**, and cause significant disruption.
  - Net revenue from last successful auction of 45 MHz realized a **net income of just a few hundred million a year** for the government. (\$5.3 billion total)
- More Efficient and Immediate Use of Federal Spectrum will be Obtained through Sharing**



Source: GAO analysis of NTIA, federal agencies, and industry information.

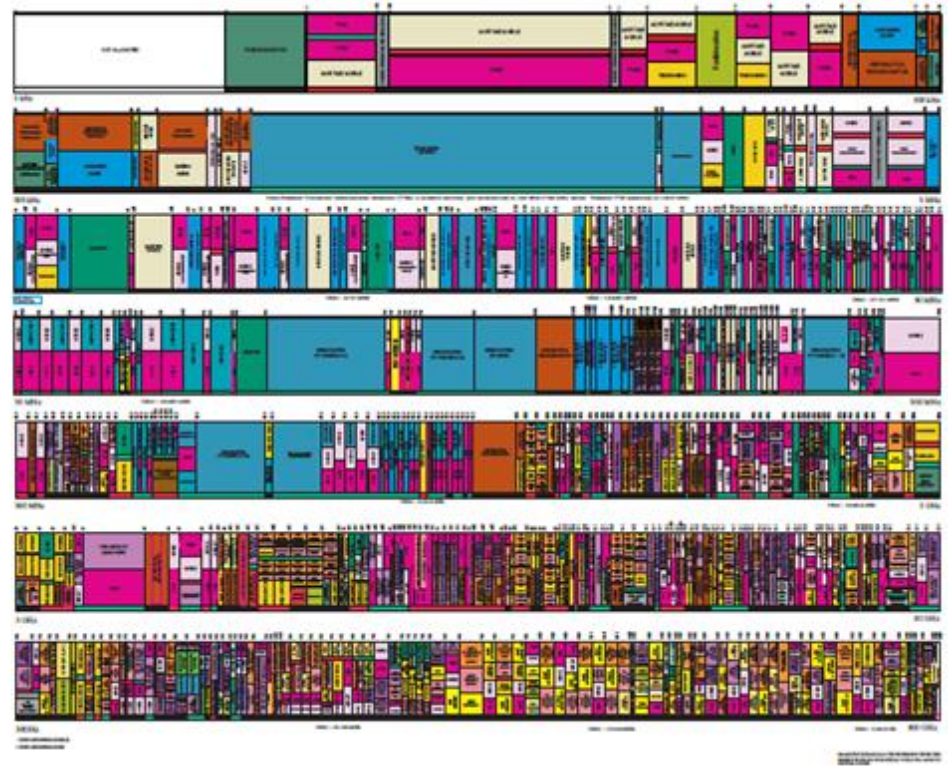


# Today: Wireless Spectrum Master Zoning Plan

Fragmentation of spectrum for exclusive Federal use leads to artificial scarcity and constraints on current and future users.

## UNITED STATES FREQUENCY ALLOCATIONS

### THE RADIO SPECTRUM



# Result: Scarcity Amidst Abundance

- **NSF studies of actual spectrum use show < 20% beachfront spectrum used in even most congested cities**
- **Status Quo can not meet demand**
  - **Seamless, high capacity mobile connectivity will require an enormous increase in overall “cleared” spectrum capacity that is not available**
  - **Even move to LTE may only increase supply by 5X compared to 50X demand in 5-10 years**
- **Spectrum licenses are scarce**
- **Increases in Capacity require:**
  - **More spectrum reuse**
  - **More effective use of wired backhaul**

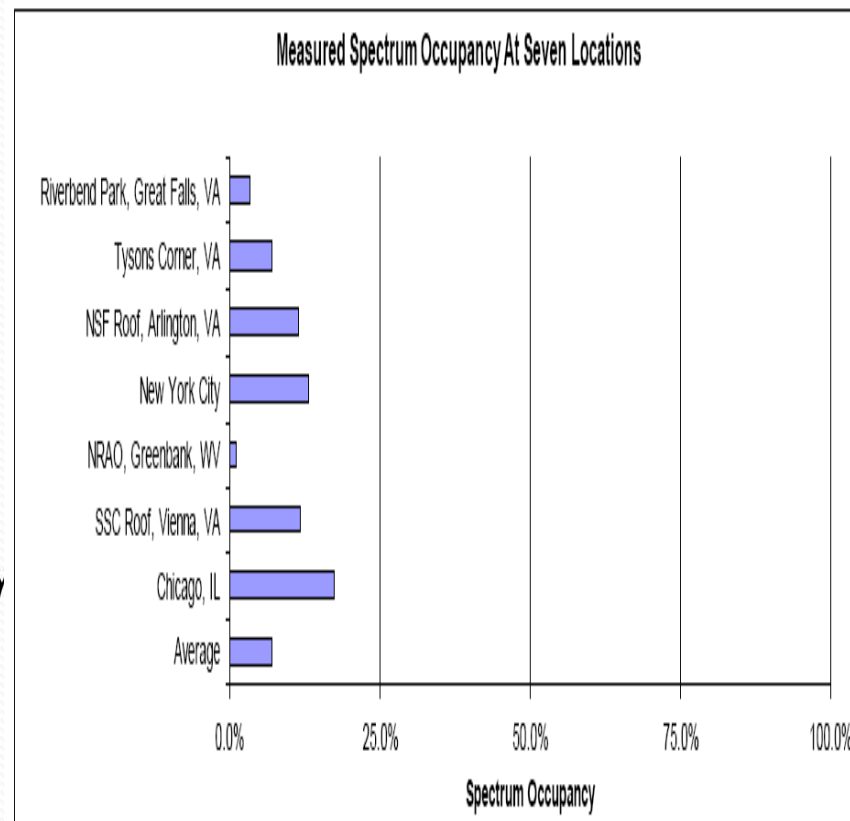


Figure 75 Overall Spectrum Occupancy Measured at Seven Locations

# Tomorrow: Shared-Use Spectrum Superhighways

PCAST recommends the President issue a new memorandum that:

- states the policy of the U.S. government is to share underutilized Federal spectrum; and
- identifies immediately 1,000 MHz of Federal spectrum for sharing with the private sector; and

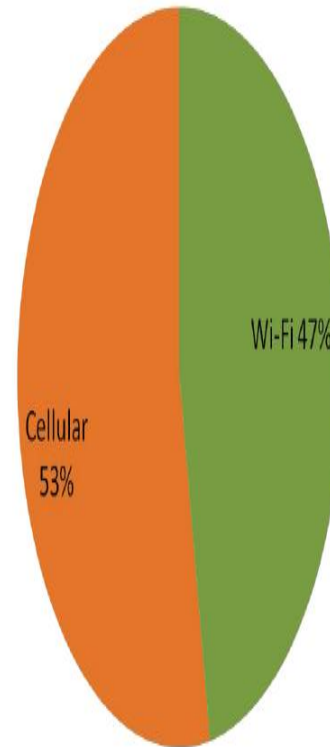
## The New Spectrum Superhighway:

- Divides spectrum into substantial blocks with common characteristics
- Makes sharing by Federal users with commercial users the norm
- Measures spectrum effectiveness using a new metric
- Increases capacity by 1,000's of times.

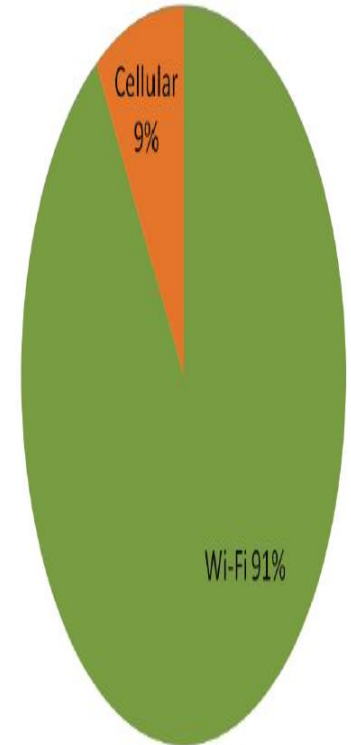


# Sharing is not New and We Know How To Do It

- **Over 50% of licensed spectrum is statically shared between Federal and Commercial users today in a controlled and planned fashion**
- **Unlicensed spectrum proves vendors will invest in shared spectrum and drive opportunities in innovation**
- **WiFi for enhanced cellular carrier offload, despite its shared and less predictable nature, carries over 40% of mobile data traffic and is fast growing as user experience improves**



Share of iPhone data traffic



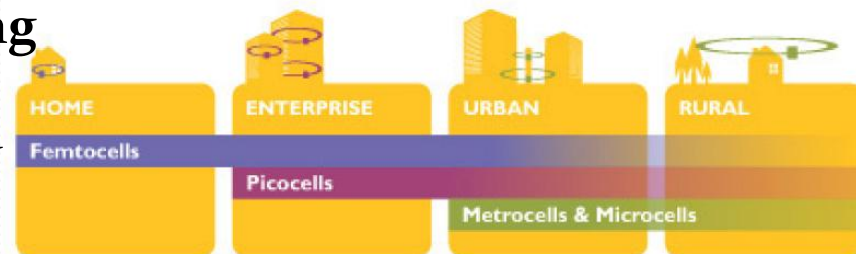
Share of iPad data traffic

Source: ComScore Digital Omnivores, Oct. 2011



# Start Now: Use Existing Technologies

- **Database Management Technology**
  - Geo-location Database Management is already being implemented by FCC in TV Band
- **Policy Immediately Enables Existing Technologies such as Small Cell**
  - Optimized for Aggregate Capacity
  - Lower power technologies make sharing with Federal users more viable
  - Can exploit spectrum unsuitable for high power uses
- **PCAST report Not Dependent on new device technologies like Cognitive Radio, Smart Antenna, DSA**
  - a sharing architecture will accelerate innovation cycles and investments
  - they will further increase effectiveness

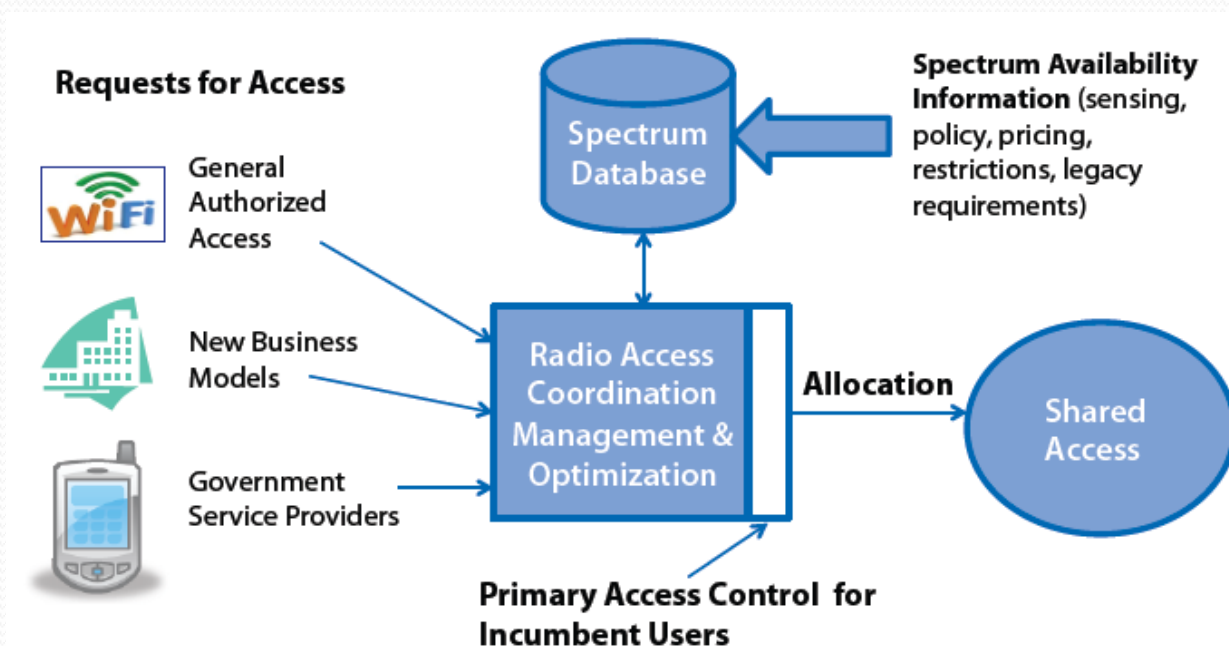


# Recommended: New Federal Spectrum Access System

- **Implement a Federal Spectrum Access System**

- **Hierarchy of Users**
  - **Federal Primary Access (Incumbent)**
  - **Secondary Exclusive Access (Accommodates non-shared access technologies like LTE or Quality of Service Applications)**
  - **General Authorized Access**
- **Geo-location Database with policy information**
- **Sensing option for Federal Systems**

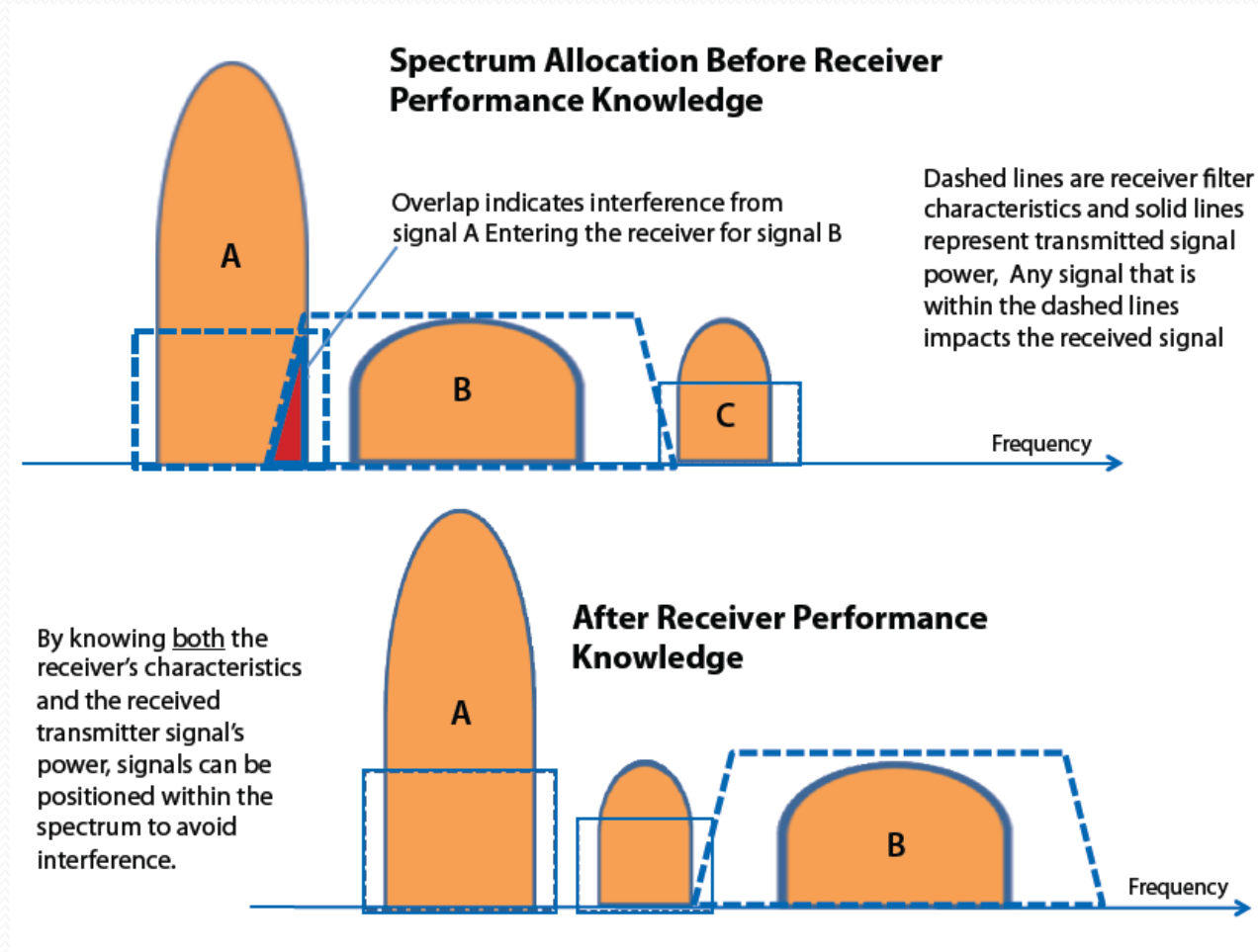
- **Allow Access to Unused Spectrum**



# Recommended: Receiver Management Framework

- Receiver not just Transmitter Focus

- Establish minimum technical standards for coexistence of transmitters and receivers to enable flexible sharing. Many ways to consider it.



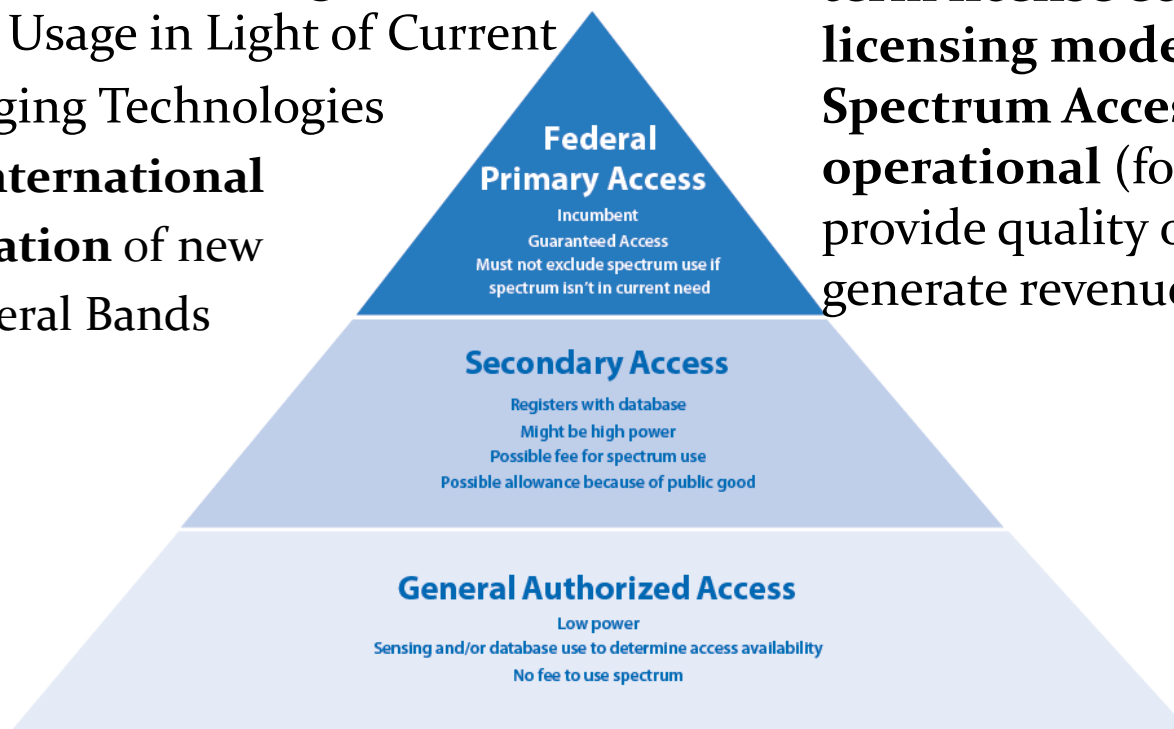
# Recommended: Federal Spectrum Management Mechanisms

- **Formalize a White House-based Spectrum Management Team (SMT)** of the U.S. Chief Technology Officer, National Security Staff, Office of Management and Budget, and National Economic Council to work with the National Telecommunications and Information Administration.

- **Reexamine Partitioning of Federal Spectrum Usage** in Light of Current and Emerging Technologies

- **Support International Harmonization** of new Shared Federal Bands

- **Implement a Mechanism that gives Federal Agencies Incentives to Share Spectrum** (e.g., Spectrum Currency)
- **Redefine Existing Spectrum Relocation Fund to Revolving “Spectrum Efficiency Fund”**
- **Experiment with new shorter-term license economic licensing models once a Spectrum Access System is operational** (foster innovation, provide quality of service, generate revenue)

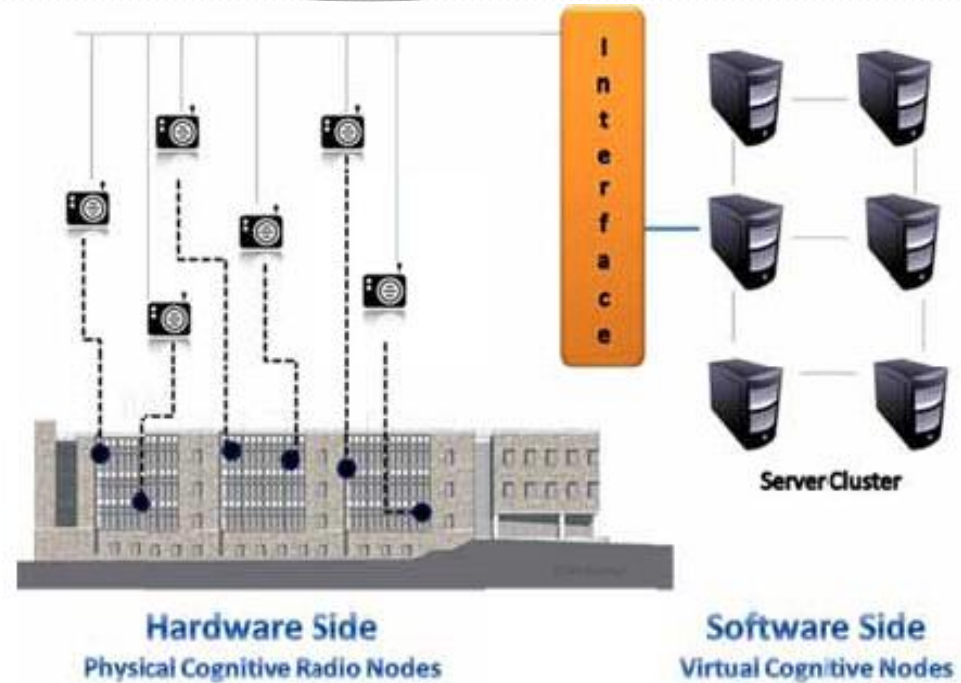


# Benefits and Barriers in Getting Started

- **Benefits to Federal Agencies, especially DoD**
  - Eliminate the need for future clearing of spectrum by DoD, ensuring continuity of mission and avoiding major costs associated with the change;
  - Enable military spectrum agile systems to leveraging commercial production;
  - Simplify stateside training by providing access to a wide range of frequencies on a shared basis; and
  - Increase US military effectiveness in deployed environments by offering more flexible equipment that can both leverage and better “hide” within local spectrum.
- **The key barrier to progress remains the trust gap between the commercial and federal user communities.**
  - Federal users must be comfortable that spectrum sharing will not cause harmful interference and that they will have assured access to their spectrum when and where they need it.
  - Commercial users need to gain confidence that the shared spectrum can lead to a viable business model.
  - Neither side has been satisfied with the data generated from simulation or field trial in remote locations.

# Recommended: Immediate Pilot Actions

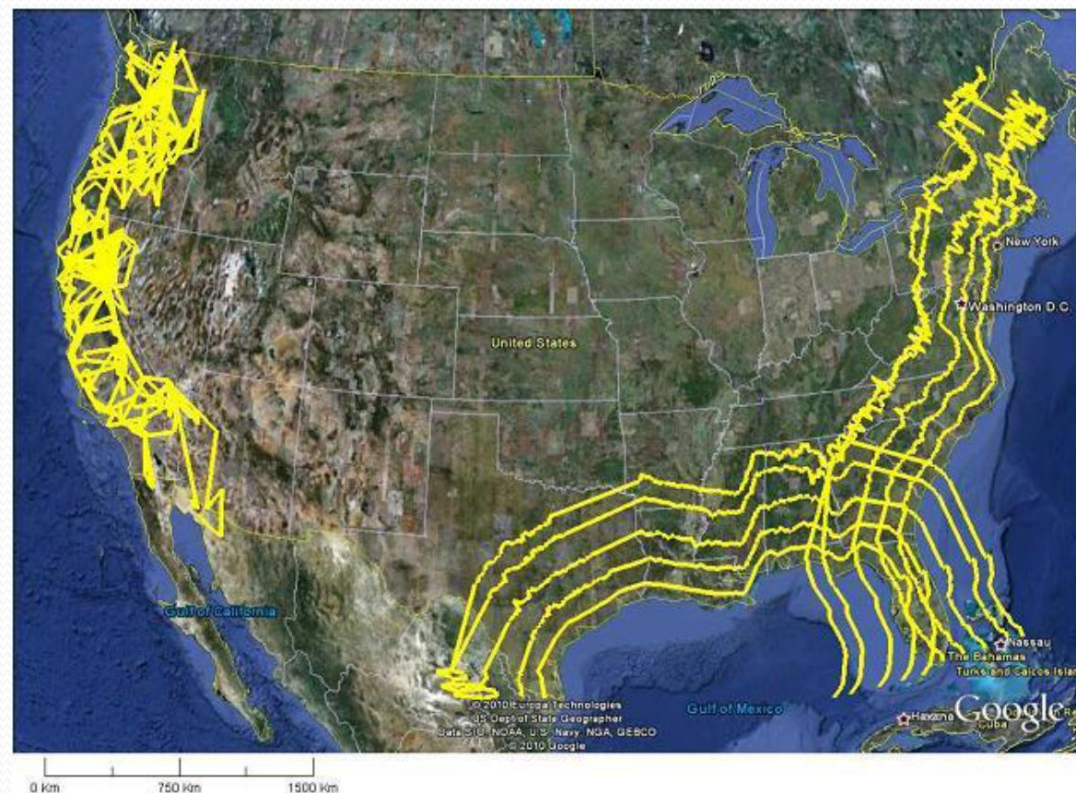
- **Establish Spectrum Sharing Partnership Steering Committee** - an Advisory Committee of C-level Industry Representatives – to Advise on Federal Spectrum Sharing System Implementation
- **Specify and fund the ongoing Scalable Real-World Test Services needed** (a Test City and Mobile Test Service) to test sharing of Federal Bands and Public Safety with industry



# Recommended: Immediate Pilot Actions

## 3550-3650 MHz NTIA Exclusion Zones\*

- **Modify Rules to Allow “General Authorized Access” Devices to Operate in two bands in the NTIA Fast Track List – specifically the 3550-3650 MHz (radar bands) and a second band to be determined by FCC and NTIA**
- **Use Extended TV White Space System Already in Operation as the starting system**



NTIA Fast-Track Report, Figure 5-3. Composite Depiction of Exclusion Zone Distances, Shipborne Radar Systems

# Key Recent Activities of note today

- **Industry Leaders accelerating sharing discussion**
  - Verizon CEO offered \$5M to DoD to explore sharing on May 9, 2012
  - T-Mobile granted FCC sharing license for 1755-1780 MHz band on Aug 14, 2012
  - ASA (Authorized Shared Access) / LSA (Licensed Shared Access) system proposed by Qualcomm, Nokia, Ericsson to European Commission (2011,2012)
- **FCC to implement PCAST recommendation for sharing in 3550-3650 band**
  - Chairman Genachowski announcement at Stanford on Sept 12, 2012
  - Exploring small cell commercial sharing
  - Setting end of year expectation for first proposals or hearings
- **European Commission recommended a plan on Sept 4, 2012 to move spectrum sharing forward in EU using a hierarchical access system**
- **Wireless Innovation Forum voted and announced broad support of PCAST recommendations on Sept 4, 2012**
- **House Communications Subcommittee conducted public hearing on Spectrum sharing of Federal spectrum on Sept 13, 2012**
- **FCC Technology Advisory Council (TAC) committees creating reports on Receiver Frameworks and M2M secondary license sharing consistent with PCAST report – public presentations on Sept 24, 2012**
  - Receiver Standards linked into FCC Spectrum Dashboard
- **NTIA CSMAC Spectrum Sharing subcommittee reviewing Federal bands (2012 quarterly public reports)**
- **NTIA FirstNet (Public Safety) Board of Directors met on Sept 25<sup>th</sup> to create shared public safety system**



# What this Means for Innovation and Leadership

- **Licensed bands offer predictability, but...**
  - Innovators have been stifled by it being slowly planned and not disruptive
  - Cost of spectrum; Delays for clearing, or repacking; Regulatory Issues
  - Long Term Commitments and Planning cycles required
- **Unlicensed has met much of the innovator needs, but...**
  - While many new applications, such as M2M, have embraced unlicensed
  - It is congested and Its quality and availability is unpredictable
- **Sharing Federal Spectrum embraces the best of both worlds**
  - Flexibility between secondary licensed and unlicensed spectrum
  - Short term, regional licensing
  - Can iterate and experiment and “try before you buy”
  - It embraces short-range, more localized communications and small cells
- **Important dialog is ongoing about the future of wireless spectrum**
  - Continue to clear all possible spectrum while knowing that doubling of wireless demand every year cannot be met through doubling spectrum
  - Use sharable federal spectrum as an opportunity to leverage current licensed and unlicensed policies, support innovation, and motivate broad investment
- **They are not mutually exclusive**
  - A system for sharing will make Federal spectrum available for commercial use in 3 years, rather than 8-10 years
  - A system for sharing will improve Federal systems and make it easier to move equipment and produce “clearer” Federal spectrum over time

# Summary and Conclusions

- **Move Spectrum Access from Scarcity to Abundance**
  - Access to spectrum is increasingly important to economic activity, growth and innovation, world-wide leadership, and national security.
  - The strategy to clear and reallocate spectrum over the next 10 years can not include significant Federal spectrum. We must accelerate sharing.
  - NTIA and FCC must work with industry to plan to implement a new spectrum management system that can start with Federal Spectrum
- **Pilot and Learn Now**
  - Implement sharing in two Federal bands
  - Create an SSP Steering Committee of C-level industry leaders
  - Enable US Industry to establish leadership through scalable test services
  - Form a Spectrum Management Team from the White House
- **We can't wait**
  - We can have significant impact within the next 3 years
  - Dynamic sharing will lead to equipment improvements that will make it easier to move Federal systems over time and create "clearer" spectrum
  - World-wide leadership is "up for grabs" and follows first mover advantage
  - A multiple decade innovation cycle will follow

# Thank You

For More Information: [www.whitehouse.gov/ostp/pcast](http://www.whitehouse.gov/ostp/pcast)