

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

PCAST July 20, 2012

Report Card: 12 March 2014

Dennis Roberson – Vice Provost for Research
Illinois Institute of Technology

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.
- **Paul Kolodzy**, Kolodzy Consulting
- **William Lehr**, Massachusetts Institute of Technology
- **Jon Levin**, Stanford University
- **David Liddle**, U.S. Venture Partners
- **Preston Marshall**, University of Southern California
- **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

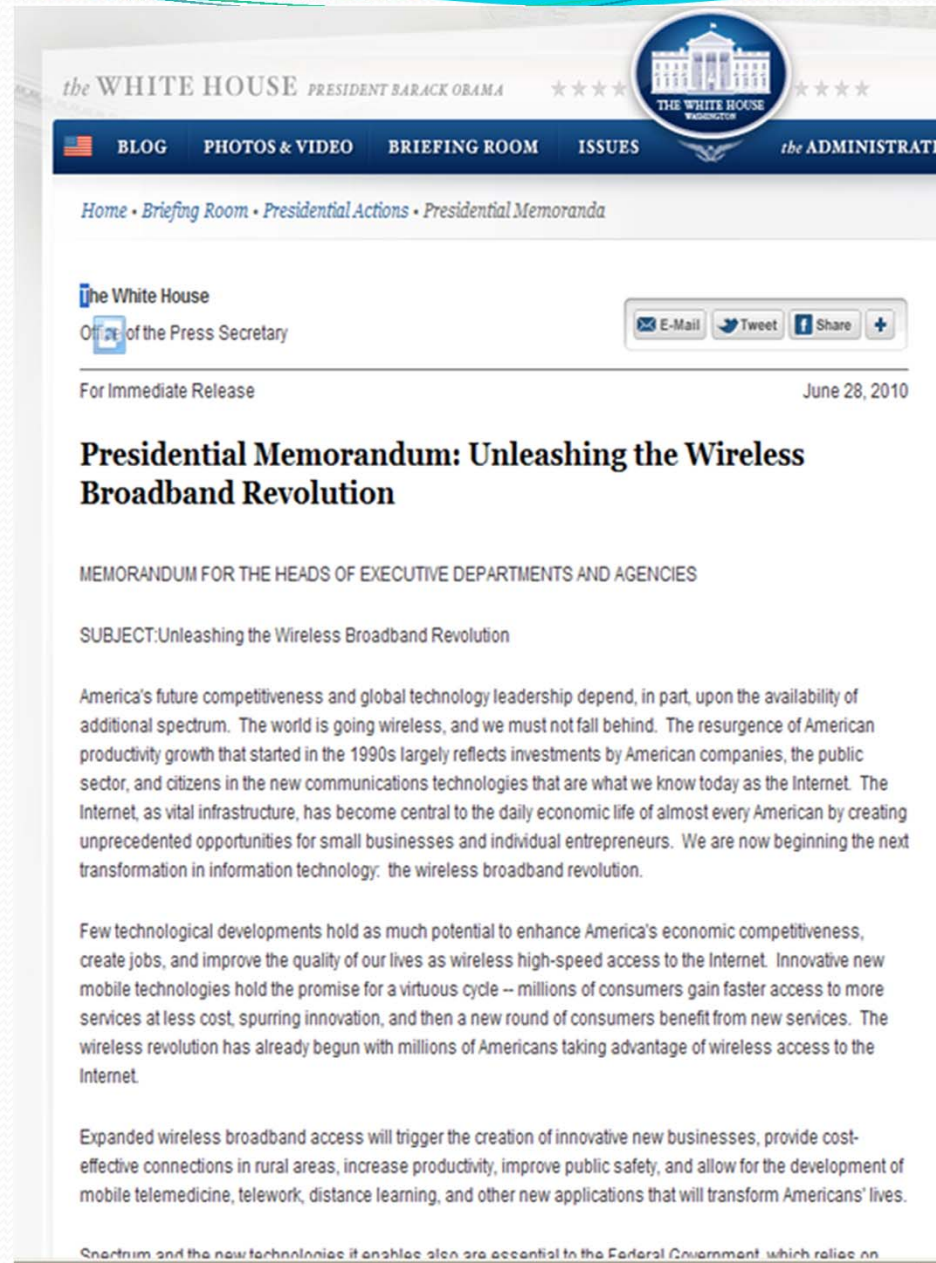
Invited Experts

- **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

President Obama and Spectrum Management

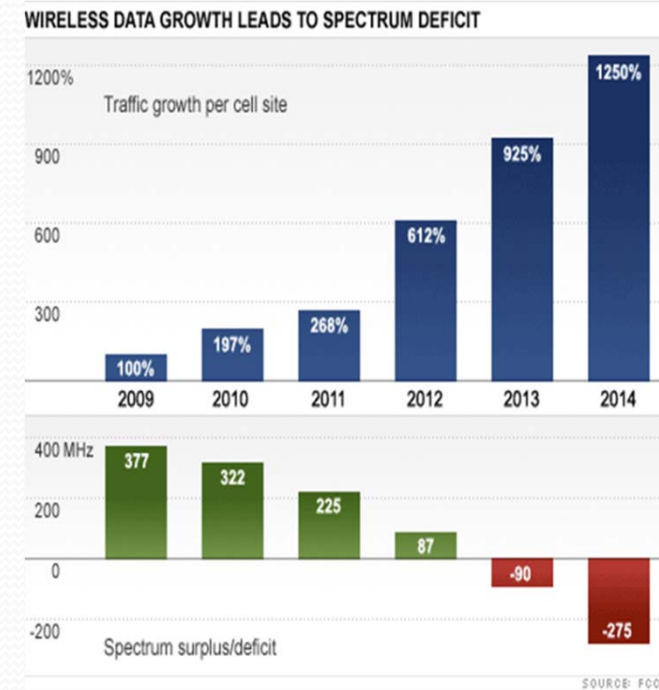
As a Follow-on to the National Broadband Plan:
First Presidential Memorandum - 28 June 2010

- Spectrum important for U.S. economic and technological leadership.
- Requires **500 MHz of spectrum** to be made available for **commercial use within 10 years** by
 - Finding ways to use spectrum more **efficiently**;
 - Unlocking the value of otherwise **underutilized spectrum**;
 - Open new avenues for spectrum users to derive value through the development of advanced, situation-aware spectrum-sharing technologies.
- **Assessment: NO CAN DO if this means cleared spectrum!**
- This PCAST reports proposes the next step to respond to the President's spectrum mandate.



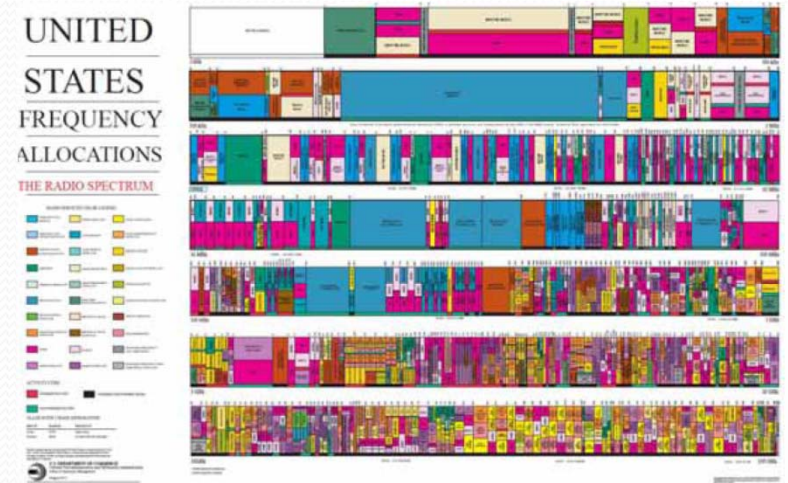
Why Do We Need to Repurpose Spectrum?

- **Huge WW Mobile Device Growth Opportunity (2020)**
 - \$4.5T Global Value
 - M2M Wave next (IoT)
 - 50B devices
 - Zetta-bytes of Data (10^{24})
- **Enhanced Mobile Devices are Already Leading to a US Spectrum Deficit**
 - Data more than doubled 4 years in a row
 - Smartphones generate 24X data of basic-feature cell phones (Everyone has one now)
 - Tablets create 5X more traffic than smartphones
- **Fragmentation of spectrum** for exclusive Federal use leads to artificial scarcity and constraints on current and future users.
- **Federal Agencies also need more Spectrum**
 - DOD unmanned aerial systems increased 45X in 8 years



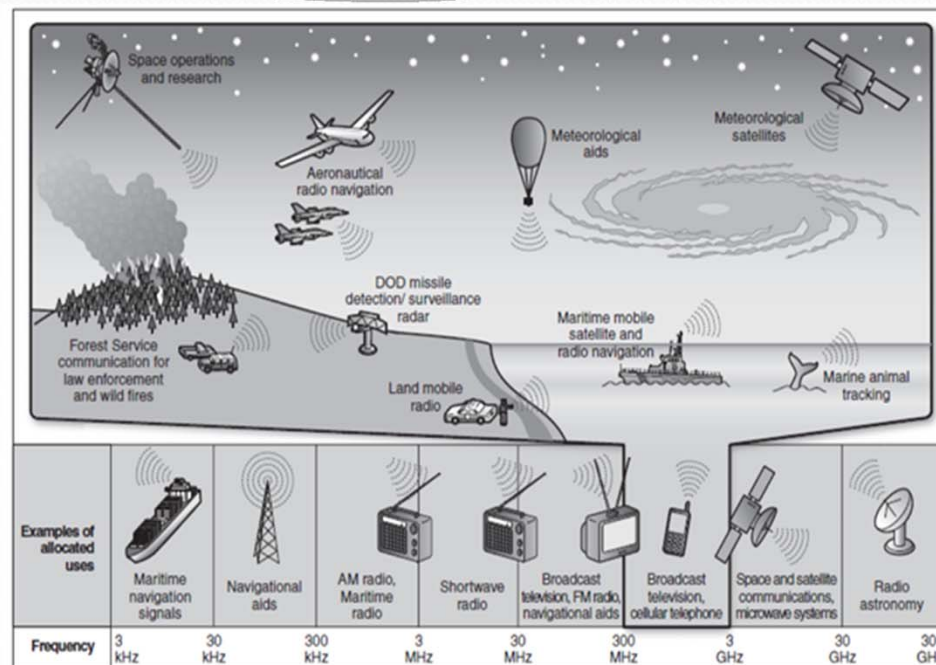
UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

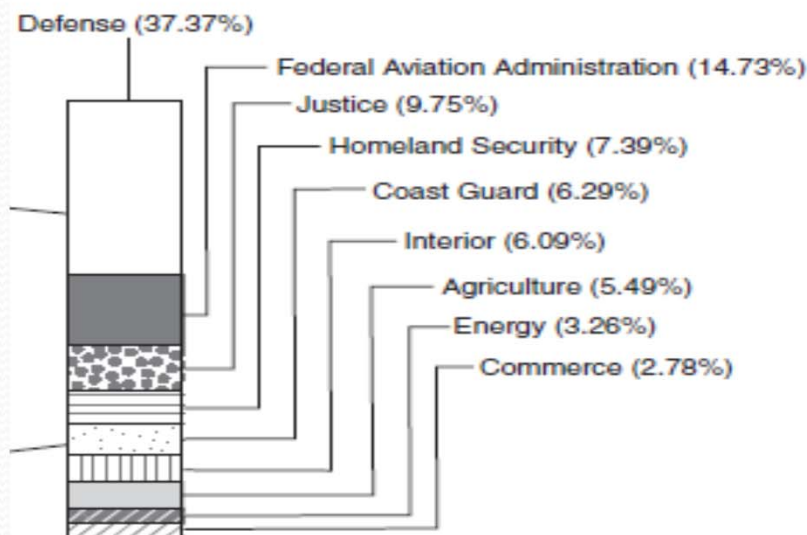


PCAST Study Concentrated on Federal Spectrum

- **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. (1755-1850 MHz)
 - Net revenue from last successful auction of 45 MHz realized a **net income of just \$5.35 billion** for the government.
 - Most Federal Bands not highly valued if they need to be cleared.
- **More Efficient Use of Federal Spectrum will be Obtained through Sharing**



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



Overarching Recommendation

PCAST recommends the President:

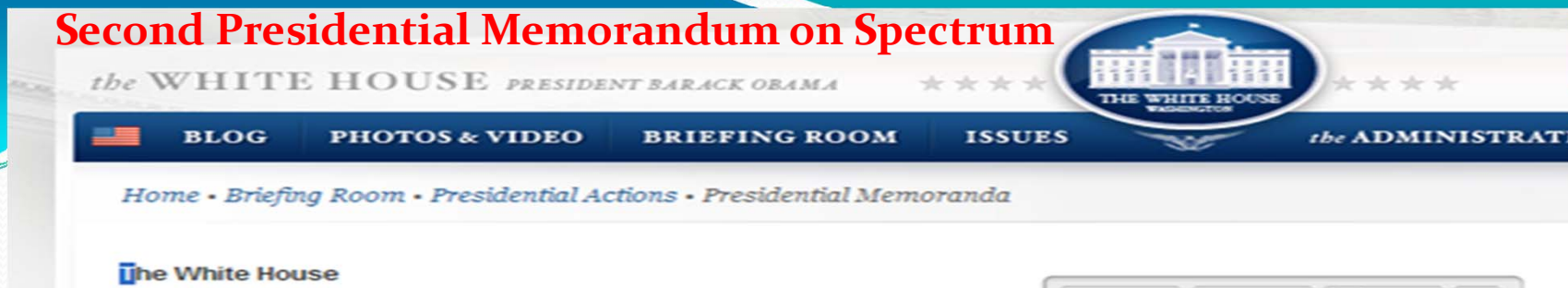
- issue a new memorandum regarding spectrum; **DONE!**
- state the policy of the U.S. government is to share underutilized Federal spectrum; **DONE!** and
- identify immediately 1,000 MHz of Federal spectrum for sharing with the private sector. **Still in Process – this is a huge challenge!**

Create the first shared-use spectrum superhighways.

- Divide into substantial blocks with common characteristics
 - **Extremely difficult given incumbency**
- Make sharing by Federal with commercial users the norm
 - **Progress clearly being made, reverse sharing also under discussion, i.e. commercial sharing with Federal users**
- Measure spectrum effectiveness using a new metric
 - **Little progress here**
- Potential impact could be 1,000's times current capacity.
 - **Opportunity is there, the cost and time is the question**



Second Presidential Memorandum on Spectrum



For Immediate Release : **June 14, 2013**

Presidential Memorandum -- Expanding America's Leadership in Wireless Innovation

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

SUBJECT: Expanding America's Leadership in Wireless Innovation

A combination of American entrepreneurship and innovation, private investment, and smart policy has positioned the United States as the global leader in wireless broadband technologies. Expanding the availability of spectrum for innovative and flexible commercial uses, including for broadband services, will further promote our Nation's economic development by providing citizens and businesses with greater speed and availability of coverage, encourage further development of cutting-edge wireless technologies, applications, and services, and help reduce usage charges for households and businesses. We must continue to make additional spectrum available as promptly as possible for the benefit of consumers and businesses. At the same time, we must ensure that Federal, State, local, tribal, and territorial governments are able to maintain mission critical capabilities that depend on spectrum today, as well as effectively and efficiently meet future requirements.

In my memorandum of June 28, 2010 (Unleashing the Wireless Broadband Revolution), I directed the Secretary of Commerce, working through the National Telecommunications and Information Administration (NTIA), to collaborate with the Federal Communications Commission (FCC) to make 500 MHz of Federal and nonfederal spectrum available for wireless broadband use within 10 years. Executive departments and agencies (agencies), including NTIA, have done an excellent job of pursuing the twin goals of advancing their agency missions and promoting innovation and economic growth. Although existing efforts will almost double the amount of spectrum available for wireless broadband, we must make available even more spectrum and create new avenues for wireless innovation. One means of doing so is by allowing and **encouraging shared access to spectrum** that is currently allocated exclusively for Federal use. Where technically and economically feasible, sharing can and should be used to enhance efficiency among all users and expedite commercial access to additional spectrum bands...

Presidential Memorandum -- Expanding America's Leadership in Wireless Innovation – 14 June 2013

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Therefore, by the authority vested in me as President by the Constitution and the laws of the United States of America, including the Federal Property and Administrative Services Act, 40 U.S.C. 101 et seq., and in order to promote economy and efficiency in Federal procurement, I hereby direct the following:

Section 1. Spectrum Policy Team. (a) The Chief Technology Officer and the Director of the National Economic Council, or their designees, shall co-chair a Spectrum Policy Team that shall include representatives from the Office of Management and Budget (OMB), the National Security Staff, and the Council of Economic Advisers. The Spectrum Policy Team shall work with NTIA to implement this memorandum. The Spectrum Policy Team may invite the FCC to provide advice and assistance.

(b) The Spectrum Policy Team shall monitor and support advances in spectrum sharing policies and technologies. Within 1 year of the date of this memorandum, the Spectrum Policy Team shall publish a report describing how NTIA and FCC are incorporating spectrum sharing into their spectrum management practices. The report shall include recommendations that enable more productive uses of spectrum throughout our economy and society and protect the current and future mission capabilities of agencies. The Spectrum Policy Team shall also assess national security, law enforcement, safety-of-life, economic, scientific, social, international, and other policy considerations related to licensed and unlicensed spectrum use, including standardization as well as the extent to which the revenue potential of spectrum auctions affects spectrum policy.

Sec. 2. Collaboration on Spectrum Sharing. (a) The Secretary of Commerce, working through NTIA, has been facilitating discussions between agencies and nonfederal entities that have produced an unprecedented level of information-sharing and collaboration to identify opportunities for agencies to relinquish or share spectrum, currently focusing on the 1695-1710 MHz band, the 1755-1850 MHz band, and the 5350-5470 and 5850-5925 MHz bands. The NTIA shall continue to facilitate these discussions and the sharing of data to expedite commercial entry into these bands where possible, provided that the mission capabilities of Federal systems designed to operate in these bands are maintained and protected, including through relocation, either to alternative spectrum or non-spectrum dependent systems, or through acceptable sharing arrangements. These discussions shall also be expanded to encompass more spectrum bands that may be candidates for shared access, specifically those in the range below 6 GHz, subject to the protection of the capabilities of Federal systems designed to operate in those bands.

(b) Within 3 months of the date of this memorandum, the Secretary of Commerce, working through NTIA and the National Institute of Standards and Technology (NIST), and building on the results from the Networking and Information Technology Research and Development Program, shall publish an inventory and description of Federal test facilities available to commercial and other stakeholders engaged in research, development, testing, and evaluation of technologies to enhance spectrum sharing and other spectrum-related efficiencies. To maximize the productive use of these facilities and to facilitate greater collaboration among agencies and nonfederal stakeholders, the Secretary of Commerce, working through NTIA, NIST, and other appropriate agencies, shall, within 6 months of the date of this memorandum, establish a plan for the development and promulgation of standard policies, best practices, and templates governing the following: research, development, testing, and evaluation of spectrum sharing technologies by and among commercial, Government, and academic stakeholders at Federal facilities.

(c) All policies, practices, and templates shall be subject to safeguards reasonably necessary to protect classified, sensitive, and proprietary data. Within 6 months of the date of this memorandum, the Spectrum Policy Team, in consultation with the Department of Justice, the National Archives and Records Administration, the Office of the Director of National Intelligence, and other appropriate agencies, shall, consistent with applicable law, including 5 U.S.C. 552, as amended by Public Law 107-306 and Public Law 11-175, and Executive Order 13526 of December 29, 2009 (Classified National Security Information), implement policies for the sharing with authorized nonfederal parties of classified, sensitive, or proprietary data regarding assignments, utilization of spectrum, system configurations, business plans, and other information.

Sec. 3. Agency Usage of Spectrum. (a) The NTIA, in consultation with the Spectrum Policy Team and appropriate agencies, shall include in its Fourth Interim Report required by section 1(d) of my memorandum of June 28, 2010, a plan directing applicable agencies to provide quantitative assessments of the actual usage of spectrum in those spectrum bands that NTIA previously identified and prioritized in its Third Interim Report and such other bands as NTIA and the Spectrum Policy Team determine have the greatest potential to be shared with nonfederal users. Each agency's assessment shall be prepared according to such metrics and other parameters as are reasonably necessary to determine the extent to which spectrum assigned to the agency could potentially be made available for sharing with or release to commercial users, particularly in major metropolitan areas, without adversely affecting agencies' missions, especially those related to national security, law enforcement, and safety of life. Each assessment shall also include a discussion of projected increases in spectrum usage and needs and shall identify where access to nonfederal spectrum could aid in fulfilling agency missions. The plan shall further require each agency to submit its assessments to NTIA and the Spectrum Policy Team within 12 months of the plan's release. In identifying spectrum bands with the greatest potential to be shared, NTIA and the Spectrum Policy Team shall consider the number and nature of Federal and nonfederal systems in a band, the technical suitability of the band for shared use, international implications, any potential for relocating Federal systems to comparable spectrum or otherwise enabling comparable capabilities, and other factors NTIA and the Spectrum Policy Team deem relevant based on consultation with agencies and other stakeholders. A band shall be identified as a candidate for shared access under this subsection only if it has been likewise identified under section 2(a) of this memorandum.

(b) The reporting of information under this section shall be subject to existing safeguards protecting classified, sensitive, and proprietary data. The NTIA shall release a summary of the assessments publicly to the extent consistent with law. The NTIA and the Spectrum Policy Team shall make any appropriate recommendations regarding the possible availability of spectrum in the subject bands for innovative and flexible commercial uses, including broadband, taking into account factors such as the nature of the Federal systems in the bands and the extent to which those systems occupy and use the bands.

(c) The NTIA shall design and conduct a pilot program to monitor spectrum usage in real time in selected communities throughout the country to determine whether a comprehensive monitoring program in major metropolitan areas could disclose opportunities for more efficient spectrum access, including via sharing. The NTIA shall work with agencies to ensure the program will not reveal sensitive or classified information. The NTIA shall consult with each agency to determine the correct technical parameters to monitor usage.

(d) Within 6 months of the date of this memorandum, NTIA shall take such actions as are necessary to require that each agency's regular reviews of its frequency assignments include a quantitative assessment of its actual usage of spectrum under such assignments.

(e) The NTIA shall also take such actions as are necessary to require that an agency requesting a frequency assignment or spectrum certification for systems operating between 400 MHz and 6 GHz verify that it must operate in this critical range, and that it will use the minimum spectrum reasonably necessary to most effectively meet mission requirements. The requesting agency shall also verify that it is not reasonable to satisfy such requirements in some other manner, such as at higher frequencies, via commercial services, or via a system that is not spectrum-dependent, whether due to cost, technology, implementation, performance reasons, international obligations, or other practical or legal constraints. In the case of system certification requests only, the requesting agency shall also present with its request a narrative explaining why its proposed solution will most effectively meet its mission requirements, in light of potential alternative approaches and all practical and legal constraints. Further, requesting agencies shall identify spectrum that will no longer be used by any legacy systems that are replaced. In implementing this subsection, NTIA shall take all steps necessary to protect against disclosure of sensitive and classified information.

Sec. 4. Spectrum Efficiency in Procurements. Agencies shall include spectrum efficiency when considering procurement of spectrum-dependent systems and hardware, as a technical requirement, an evaluation criterion for award, or both. The Director of OMB, in consultation with NTIA, shall develop and incorporate spectrum efficiency guidelines into budget and procurement processes. These guidelines shall facilitate, as appropriate, the design and procurement of systems that increase flexibility through means such as multiple-band tuning capabilities and the use of commercial systems. The guidelines also shall require, to the extent possible, procurements of Federal systems such that emission levels resulting from reasonable use of adjacent spectrum will not impair the functioning of such systems, consistent with any applicable radio receiver performance criteria and international obligations.

Sec. 5. Performance Criteria for Radio Receivers. The FCC is strongly encouraged, in consultation with NTIA, where appropriate, the industry, and other stakeholders, to develop to the fullest extent of its legal authority a program of performance criteria, ratings, and other measures, including standards, to encourage the design, manufacture, and sale of radio receivers such that emission levels resulting from reasonable use of adjacent spectrum will not endanger the functioning of the receiver or seriously degrade, obstruct, or repeatedly interrupt the operations of the receiver. In developing such a program, the FCC is strongly encouraged to give due consideration to existing policies and prudent investments that have been previously made in systems, including receivers. In its consultation with the FCC, NTIA shall provide information regarding Federal receiver standards and agency practices under those standards.

Sec. 6. Incentives for Agencies. The Spectrum Policy Team shall, within 6 months of the date of this memorandum, publish a report making recommendations to the President regarding market-based or other approaches that could give agencies greater incentive to share or relinquish spectrum, while protecting the mission capabilities of existing and future systems that rely on spectrum use. The report shall consider whether the Spectrum Currency and Spectrum Efficiency Fund proposals made by the President's Council of Advisors on Science and Technology would be effective. The report shall also analyze the impact of the Commercial Spectrum Enhancement Act of 2004 (Title II of Public Law 108-494), as modified by the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law 112-96).

Sec. 7. Rapid Deployment of Wireless Broadband. The FCC is strongly encouraged, in collaboration with NTIA, where appropriate, to expedite the repurposing of spectrum and otherwise enable innovative and flexible commercial uses of spectrum, including broadband, to be deployed as rapidly as possible by:

- (a) identifying spectrum allocated for nonfederal uses that can be made available for licensed and unlicensed wireless broadband services and devices, and other innovative and flexible uses of spectrum, while fairly accommodating the rights and reasonable expectations of incumbent users;
- (b) identifying spectrum allocated for nonfederal uses that can be made available to agencies, on a shared or exclusive basis, particularly where necessary to accommodate agencies seeking to relocate systems out of bands that could be made available for licensed services or unlicensed devices;
- (c) promulgating and enforcing rules for licensed services to provide strong incentives for licensees to put spectrum to use and avoid spectrum warehousing. Such rules may include build-out requirements or other licensing conditions as appropriate for the particular circumstance;
- (d) establishing and maintaining conditions that promote a reliable secondary market for spectrum, including provisions enabling negotiated access by agencies and users not addressed in subsection (b) of this section;
- (e) promulgating and enforcing rules for licensed services and unlicensed devices to share Federal spectrum that accommodate mission changes and technology updates by both Federal and nonfederal users; and
- (f) consulting with the Department of State regarding international obligations related to spectrum use.

Sec. 8. General Provisions. (a) Nothing in this memorandum shall be construed to impair or otherwise affect:

- (i) the authority granted by law to any agency, or the head thereof; or
- (ii) the functions of the Director of OMB relating to budgetary, administrative, or legislative proposals.

(b) Nothing in this memorandum shall be construed to require the disclosure of classified information, law enforcement sensitive information, or other information that must be protected in the interest of national security or public safety.

(c) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(d) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

(e) Independent agencies are strongly encouraged to comply with the requirements of this memorandum.

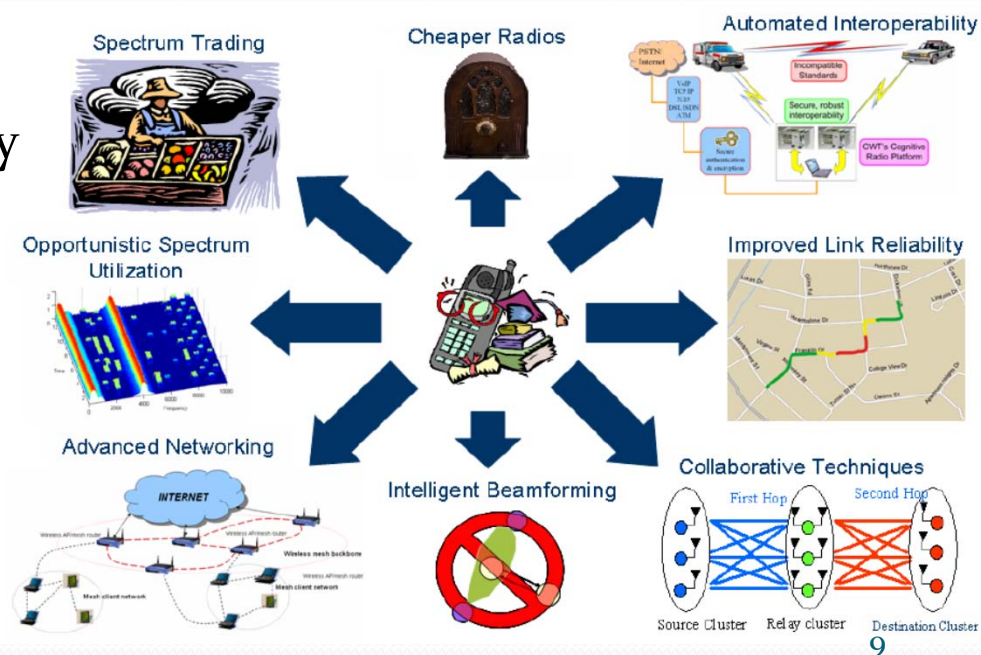
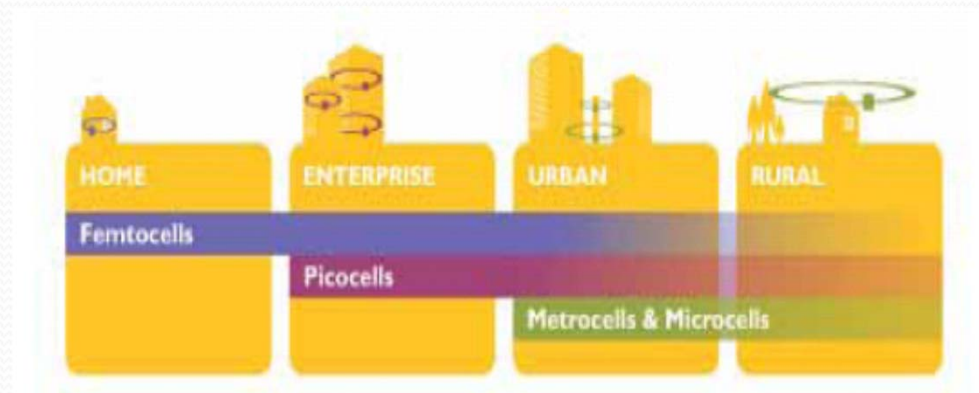
(f) The Presidential Memorandum of November 30, 2004 (Improving Spectrum Management for the 21st Century), is hereby revoked.

(g) The Secretary of Commerce is authorized and directed to publish this memorandum in the Federal Register.

BARACK OBAMA

Existing Technologies Can Lead To A New Federal Spectrum Policy Now

- We can start with existing technology – **Still the belief!**
- Database Management Technologies
 - Geo-location Database Management is already being implemented by FCC in TV Band
 - **Much Progress – FCC's 3.5 GHz Forum demonstrated this!**
- Small Cell Technologies
 - Optimized for Aggregate Capacity
 - **Great Progress!**
- Agile Radio and DSA Technologies are not required to get started
 - a sharing architecture will increase investment dollars and accelerate their innovation
 - implementation will further improve effectiveness



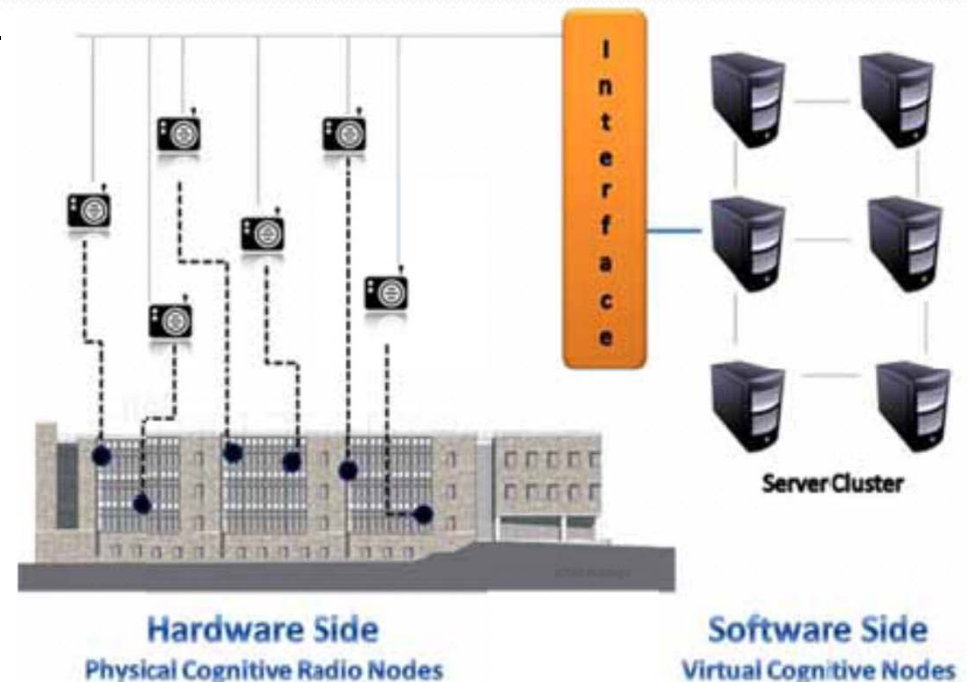
Recommended: Immediate Pilot Actions

- **Establish Spectrum Sharing Partnership Steering Committee** - an Advisory Committee of C-level Industry Representatives – to Advise on Federal Spectrum Sharing System Implementation

Progress still needed here.
CSMAC partially filling this role

- **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

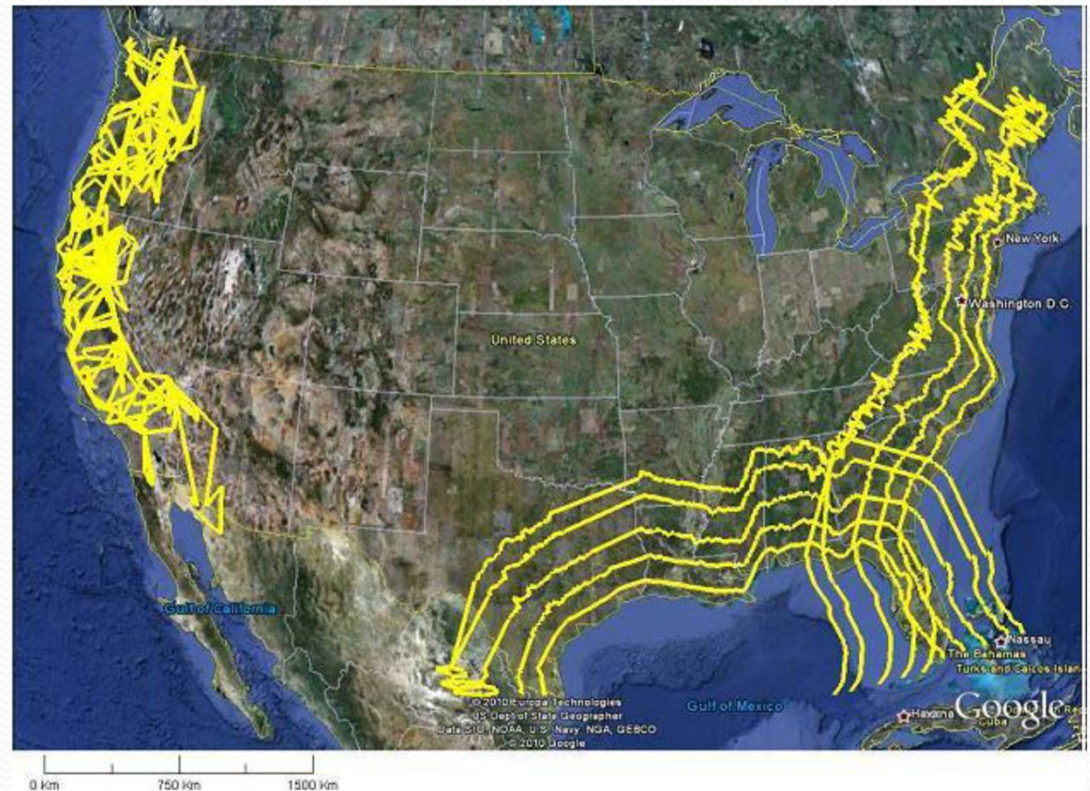
Continued interest from multiple Cities and the Federal Government especially NTIA/NIST – Test City evolving to Model Cities - In Process!



Recommended: Immediate Pilot Actions

- **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
- ***Intense Activity in this space! FCC issued two rounds of NPRMs (12/2012 – 11 / 2013) including TVWS, SAS and small cells in 3550-3650 MHz band. 3.5 GHz FCC sponsored Workshop – 14 Jan 2014. Third (Final?) NPRM expected soon.**

3550-3650 MHz NTIA Exclusion Zones*

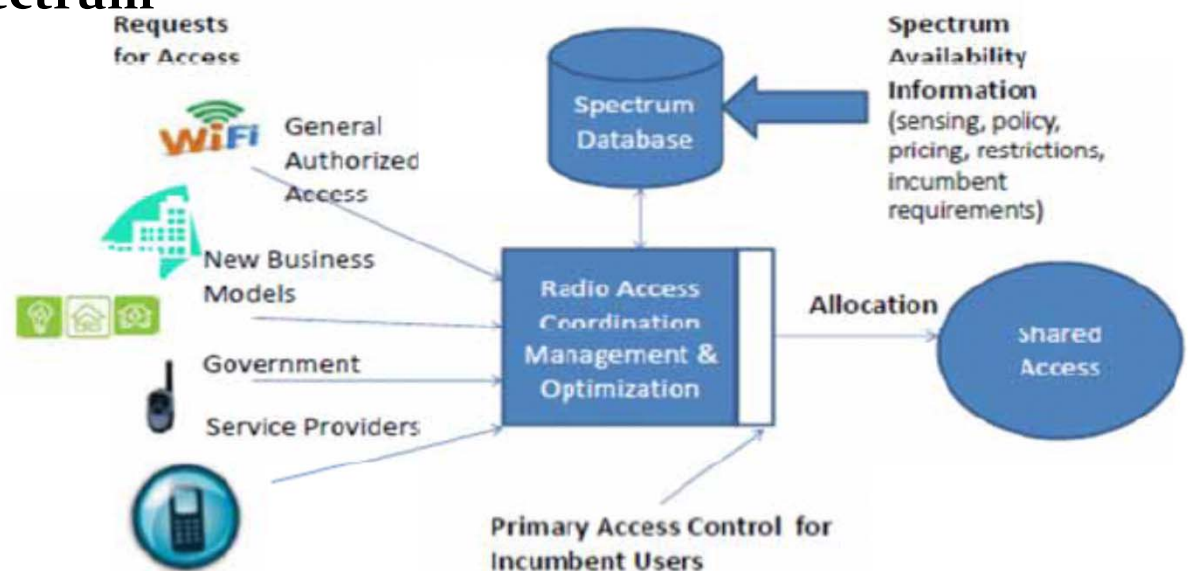


NTIA Fast-Track Report, Figure 5-3. Composite Depiction of Exclusion Zone Distances, Shipborne Radar Systems

Recommended: New Federal Spectrum Access System

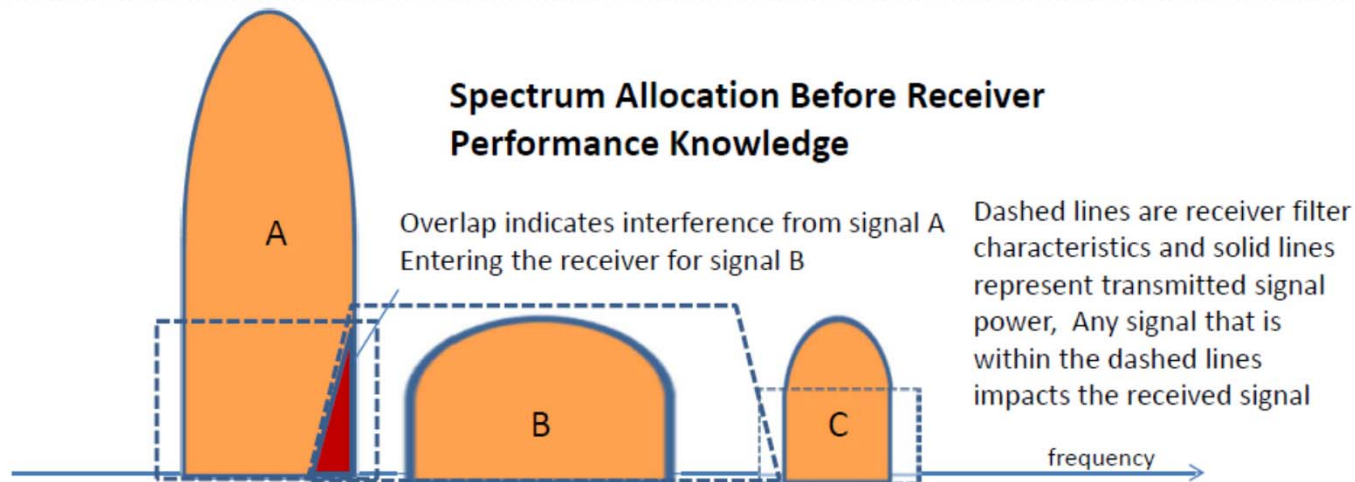
- Implement a Federal Spectrum Access System (**SAS**)— **Great Progress Here, but much additional work to do as well!**
 - Hierarchy of Users
 - Federal Primary Access (Incumbent)
 - Secondary Exclusive Access (Accommodates non-shared access technologies like LTE or Quality of Service Applications)
 - General Authorized Access
 - (3 Tier structure contrasts with European 2 Tier Licensed Shared Access Structure)
 - Geo-location Database with policy information
 - Sensing option for Federal Systems
- Allow Access to Unused Spectrum

Included in 3.5 GHz NPRM process. Much commercial effort in this area building on TVWS efforts!

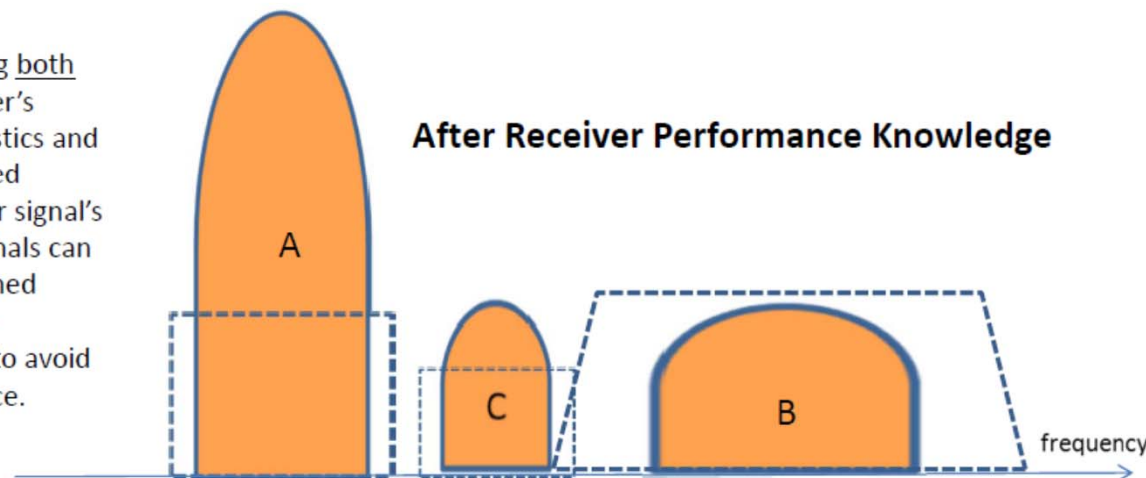


Recommended: Receiver Management Framework

- **Receiver not just Transmitter Focus**
 - Establish minimum technical standards for coexistence of transmitters and receivers to enable flexible sharing. Many ways to consider it.



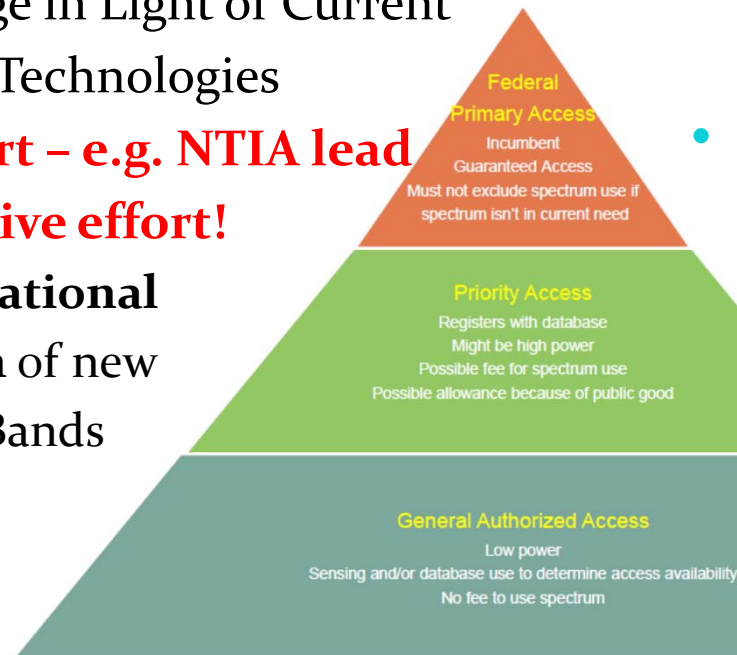
By knowing both the receiver's characteristics and the received transmitter signal's power, signals can be positioned within the spectrum to avoid interference.



*Two years worth of FCC TAC Working Group efforts in this area. Interference Limits Policy White Papers, Multi-stakeholder Group effort and technology studies / paper. Much progress being made in this area, but still much to be done.

Recommendation: Federal Spectrum Management Oversight

- **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. **In Place!**
- **Reexamine Partitioning of Federal Spectrum Usage in Light of Current and Emerging Technologies**
On-going effort – e.g. NTIA lead CSMAC Intensive effort!
- **Support International Harmonization of new Shared Federal Bands**
WRC Item
- **Implement a Mechanism that gives Federal Agencies Incentives to Share Spectrum** (e.g., Spectrum Currency) **Now on the docket - House Energy / Commerce Committee passed bill. 11 Dec 2013 – CASH to agency!**
- **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) **FCC actions focused in this area with much progress being made.**



2012-13 CSMAC Working Groups

- **WG1 1695 - 1710 MHz Weather Satellite Receive Earth Stations**
- **WG2 1755 - 1850 MHz Law Enforcement Surveillance, explosive ordnance disposal and other short range links**
- **WG3 1755 - 1850 MHz Satellite Control Links and Electronic Warfare**
- **WG4 1755 - 1850 MHz Fixed Point-to-Point, Tactical Radio Relay and Joint Tactical Radio System (JTRS)**
- **WG5 1755 - 1850 MHz Airborne Operations (ACTS, AMT, SUAVs, and PGMs)**
- **1695-1710 MHz - Coordinated usage near Earth Stations, otherwise, licensed commercial use**
- **1755-1780 MHz - To be “cleared” and re-allocated to licensed commercial (cellular?) use**

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.
More important now than even two years ago!
 - The strategy to clear and reallocate spectrum over the next 10 years will not include significant Federal spectrum. We must accelerate sharing.
NTIA / CSMAC and FCC efforts in this area!
- Clear the Policy Hurdles starting with Federal Spectrum
 - NTIA and FCC must start to plan and implement a new architecture and spectrum management system to create the spectrum super highways.
Underway by both bodies both independently and together.
- Pilot and Learn Now
 - Implement sharing in two Federal bands – **3.5 GHz, 1695-1710 MHz...**
 - Create an SSP Steering Committee of C-level industry leaders – **Not yet.**
 - Specify and provide scalable test services – **Multiple efforts: NTIA/NIST**
 - Form a Spectrum Management Team from the White House – **DONE**
- We can't wait
 - We can have significant impact within the next 3 years – **Tick, Tick, Tick...**



2013-14 CSMAC Subcommittees

- **Enforcement** (especially in a shared spectrum world)
- **Transitional Sharing** (1755-1780 initial focus)
- **General Occupancy Measurements / Quantification of Federal Spectrum Use** (knowing what is going on)
- **Spectrum Management via Databases** (think SAS with a Federal overlay to protect national interests)
- **Federal Access to Non-Federal Bands** (especially on DoD bases)
- **Spectrum Sharing Cost Recovery Alternatives** (especially when spectrum is allocated to Unlicensed use)

2013 FCC - Technological Advisory Council Work Groups with Actions

- **Spectrum Frontiers**
 - NOI - mobile service rules adoption in 30-40 GHz and host a workshop focusing on technologies for mobile broadband in this band
 - Establish framework for passive services co-existence for >95GHz bands – rules changes?
- **Spectrum and Receiver Performance**
 - Encourage multi-stakeholder (MSH) group to pilot interference limits policy - 3.5 GHz band
 - Issue a Notice of Inquiry (NOI) to initiate standards development organization action with respect to radio systems standards
 - Convene interference resolution / enforcement workshop and share interference complaints and resolutions information
- **Commercial Off The Shelf (COTS)**
 - Hold workshop on enterprise services in broadband wireless network environment
- **Cloud Infrastructure Security**
 - Accountability - Develop easy-to-access and easy-to-understand content to make Cloud Consumers aware of roles and responsibilities, suitability of services to match needs, and to comprehend the complexity of “Cloud Offerings”
 - Industry Collaboration – Partner with other Federal Agencies to nurture stake holder participation in gathering, improving, and disseminating best practices for security.
- **Resiliency**
 - FCC National program on a collaborative restoration approach in response to outages /disasters to increase resiliency and long-term reliability.
 - Use network data sources to better track and predict reliability and resiliency for disaster preparedness and long term planning.

2014 FCC - TAC Work Groups

- **Spectrum Efficiency and Receiver Performance** (includes a focus on Technologies, Interference Limits Policy and Interference Resolution and **Enforcement**)
- **Cybersecurity Initiatives** (the role for the FCC and needed technologies and standards)
- **Advanced Sharing and Enabling Wireless Technologies** (includes a spectrum sharing technology and Model City focus)
- **Internet of Things (IoT)** (and its impacts on the Internet and FCC rules)
- **Supporting the Transition to IP** (from PSTN with focuses on the disabled, rural users, specialized equipment and disaster related emergency services)



Questions?

The background is a solid blue gradient, transitioning from a lighter blue at the top to a darker blue at the bottom. A series of wavy, horizontal lines in a lighter blue shade are positioned near the top of the image, creating a sense of movement or a horizon line.

Thank You