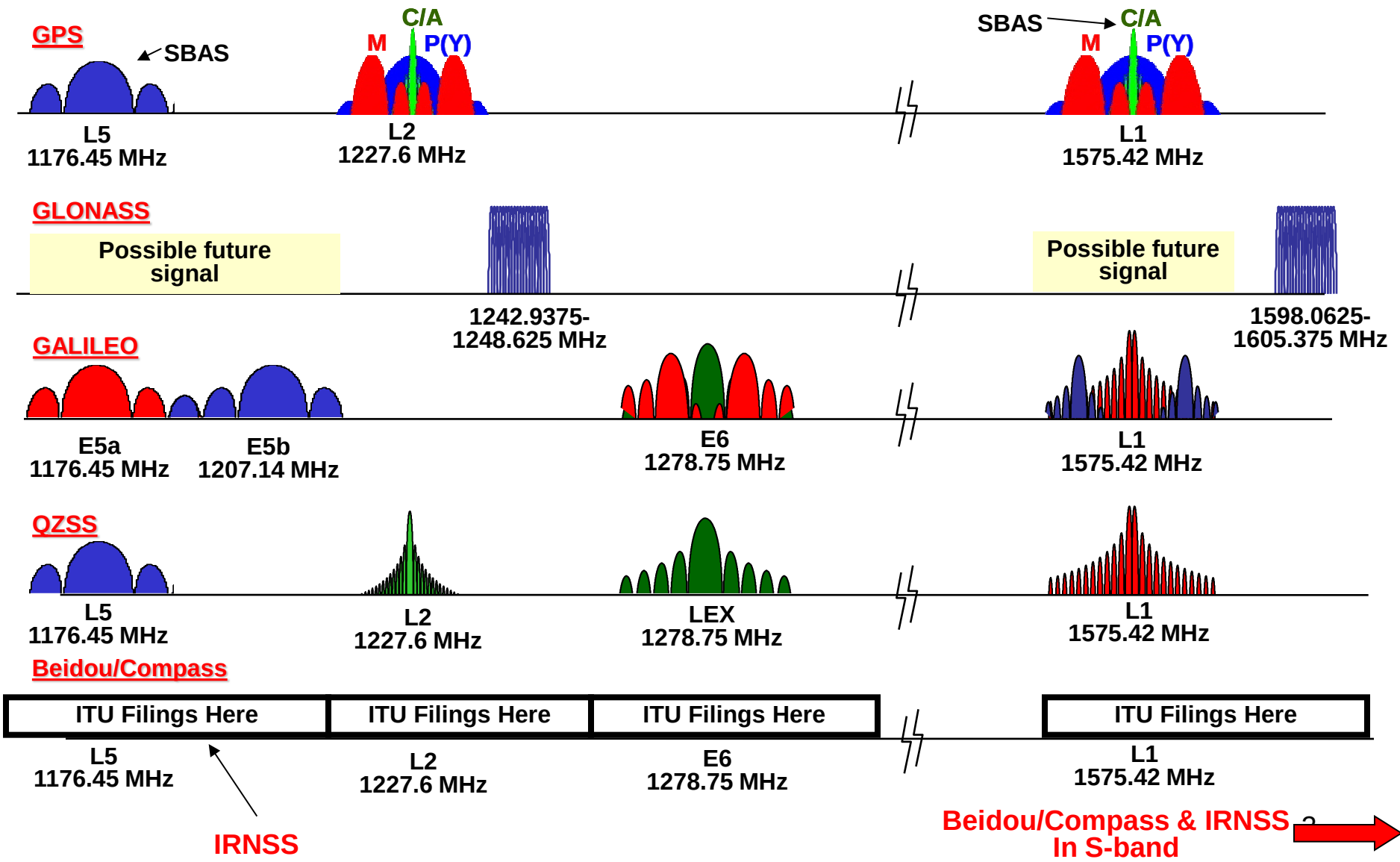
Spectrum Issues

FGCS Spectrum Working Group
26 February 2015

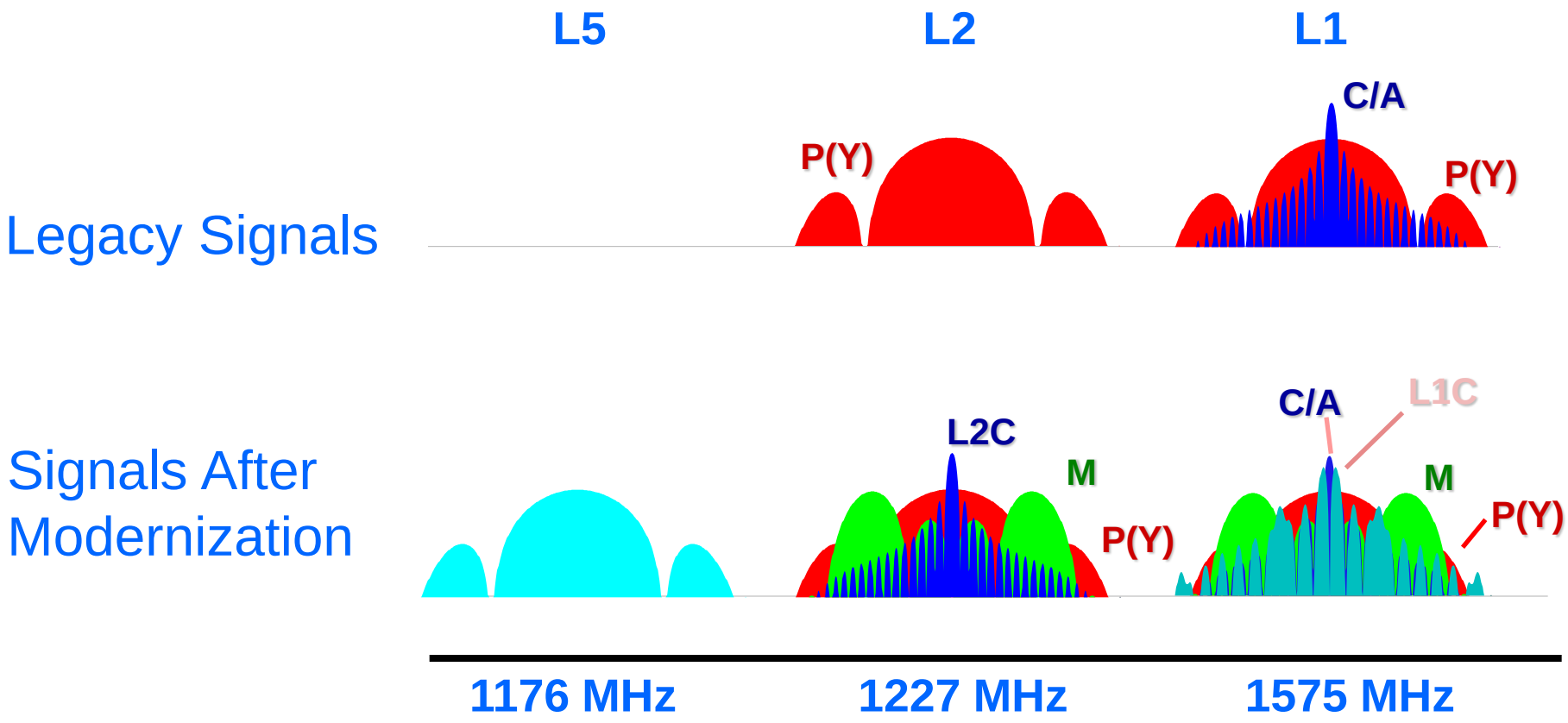
Possible topics for discussion

- **GPS adjacent band compatibility assessment study**
- **GPS/GNSS signal re-radiators, jammers and pseudolites**
  - **FCC rules**
- **Reallocation of Federal spectrum for commercial wideband Internet access**
  - **USGS Radio Advisory Committee (RAC) setup in 2014 to coordinate reallocation**

GNSS Frequency Bands & Signals



GPS Signal Modernization

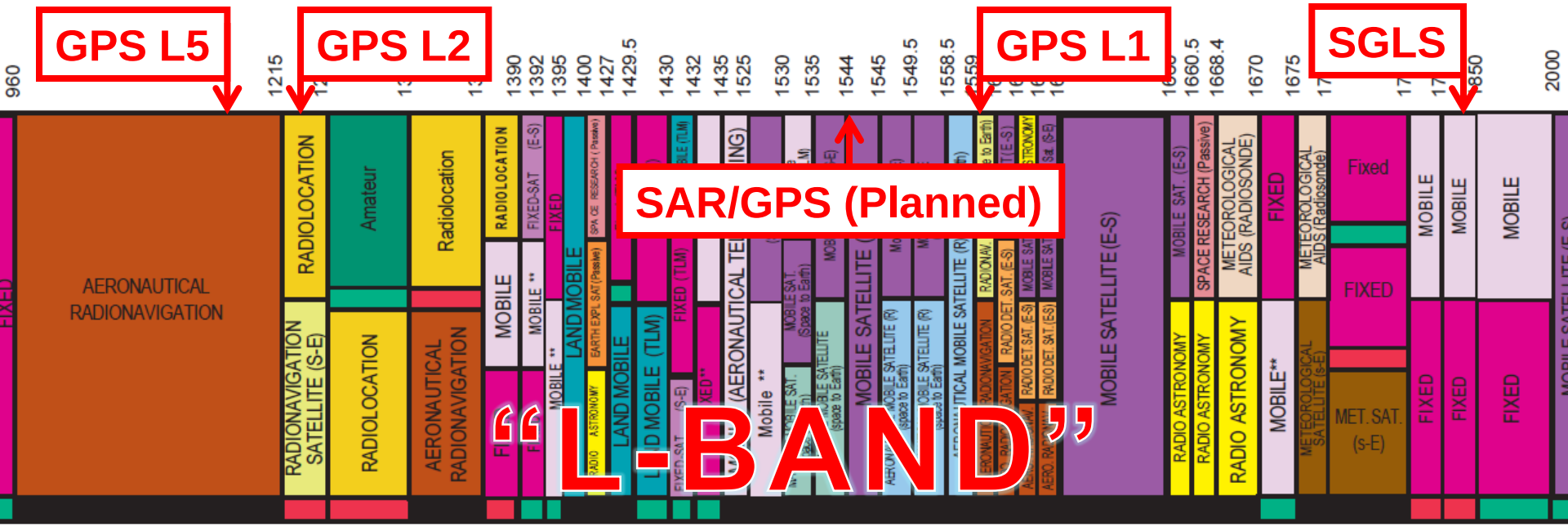


L2C = Second civil signal (now on 12 satellites, 24 by ~2018)
L5 = Third civil signal (now on 5 satellites, 24 by ~2021)
L1C = Fourth civil signal (first launch in 2016, 24 by ~2026)

MITRE

Adjacent-Band Compatibility (ABC)

- **A signal's ability to operate free of harmful degradation (interference) from other transmissions in the nearby areas of the electromagnetic spectrum**
- **Adjacent-band interference (ABI) can occur as the result of an adjacent band's power and proximity to a signal as well as inadequate filtering and/or tuning**



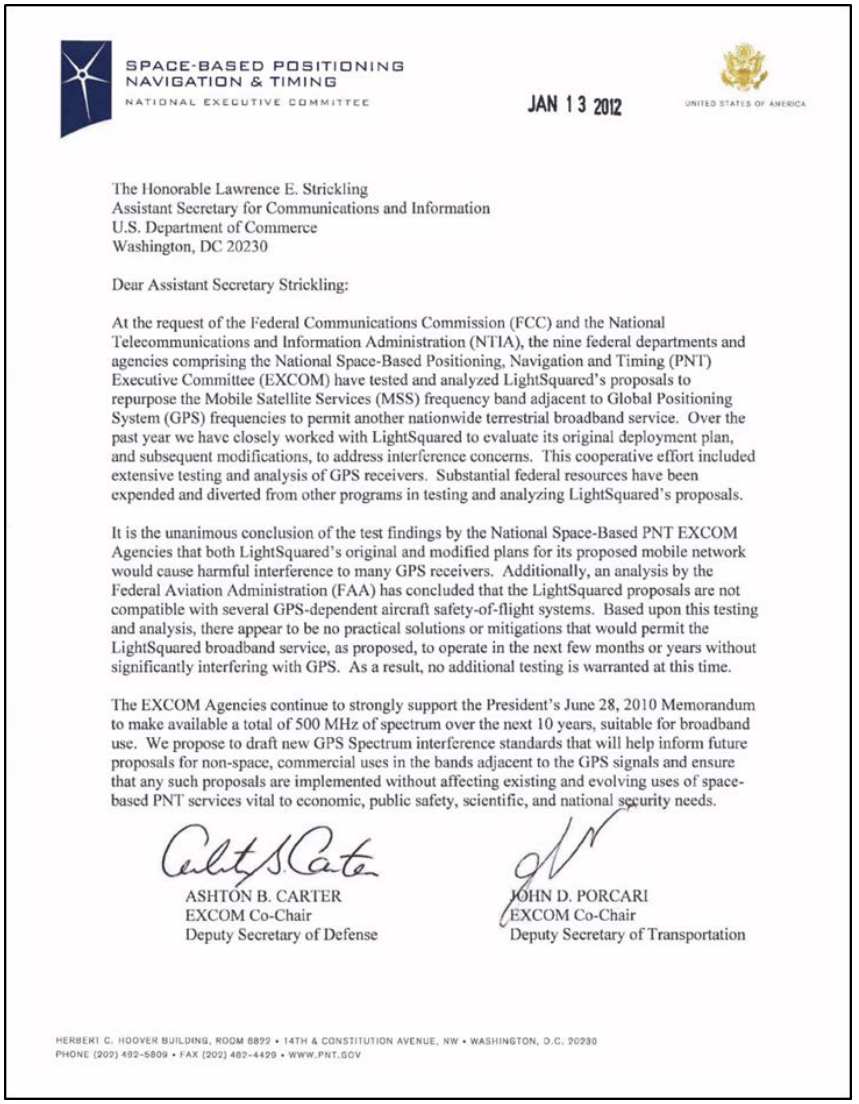
*National Telecommunications and Information Administration (NTIA) Table of Allocations in the L-Band (1-2GHz, IEEE)

Radio Frequency Compatibility

- Ensures that signals do not unacceptably interfere with use of other signals
- Requires thorough consideration of detailed technical factors, including
  - Effects on receiver noise floor
  - Crosscorrelation between interfering and desired signals

January 2012 Space-Based PNT EXCOM

- **January 13, 2012 National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee (EXCOM) co-chair letter to National Telecommunications and Information Administration (NTIA) proposed to draft new Global Positioning System (GPS) spectrum interference standards:**
  - Inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals.
  - Ensure such proposals are implemented without affecting existing and evolving uses of space-based PNT that are vital to economic, public safety, scientific, and national security needs.



SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL EXECUTIVE COMMITTEE

JAN 13 2012

UNITED STATES OF AMERICA

The Honorable Lawrence E. Strickling
Assistant Secretary for Communications and Information
U.S. Department of Commerce
Washington, DC 20230

Dear Assistant Secretary Strickling:

At the request of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), the nine federal departments and agencies comprising the National Space-Based Positioning, Navigation and Timing (PNT) Executive Committee (EXCOM) have tested and analyzed LightSquared's proposals to repurpose the Mobile Satellite Services (MSS) frequency band adjacent to Global Positioning System (GPS) frequencies to permit another nationwide terrestrial broadband service. Over the past year we have closely worked with LightSquared to evaluate its original deployment plan, and subsequent modifications, to address interference concerns. This cooperative effort included extensive testing and analysis of GPS receivers. Substantial federal resources have been expended and diverted from other programs in testing and analyzing LightSquared's proposals.

It is the unanimous conclusion of the test findings by the National Space-Based PNT EXCOM Agencies that both LightSquared's original and modified plans for its proposed mobile network would cause harmful interference to many GPS receivers. Additionally, an analysis by the Federal Aviation Administration (FAA) has concluded that the LightSquared proposals are not compatible with several GPS-dependent aircraft safety-of-flight systems. Based upon this testing and analysis, there appear to be no practical solutions or mitigations that would permit the LightSquared broadband service, as proposed, to operate in the next few months or years without significantly interfering with GPS. As a result, no additional testing is warranted at this time.

The EXCOM Agencies continue to strongly support the President's June 28, 2010 Memorandum to make available a total of 500 MHz of spectrum over the next 10 years, suitable for broadband use. We propose to draft new GPS Spectrum interference standards that will help inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals and ensure that any such proposals are implemented without affecting existing and evolving uses of space-based PNT services vital to economic, public safety, scientific, and national security needs.

ASHTON B. CARTER
EXCOM Co-Chair
Deputy Secretary of Defense

JOHN D. PORCARI
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Deputy Secretary of Transportation

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GPS Adjacent Band Compatibility Assessment

- DOT Deputy Secretary Tasking :
  - Develop a spectrum protection plan which provides a framework to define the processes and assumptions for development of GPS spectrum protection criteria on behalf of GPS civil users.
- GPS Adjacent Band Compatibility Assessment will identify the processes for:
  - Deriving adjacent-band power limits, as a function of offset frequency, necessary to ensure continued operation of all applications of GPS services.
  - Determining similar levels for future GPS receivers utilizing modernized GPS and interoperable Global Navigation Satellite System (GNSS) signals.

GPS Adjacent Band Compatibility Assessment Workshop II

Aerospace Corporation
2310 E El Segundo Blvd, El Segundo, CA 90245 Building A1, Room Titan IVA (first floor)
AT&T dial-In: 877-336-1280, Passcode 4472747
WebEx: https://volpecenterevents.webex.com/volpecenterevents/onstage/g.php?t=a&d=660350730
December 4, 2014 Meeting Agenda

PDF

10:00 AM	Introductions and Welcoming Remarks	Dr. Malina Hills, Vice President of Space Program Operations, Aerospace Corporation
10:15AM	Initial Comments and Remarks	Karen Van Dyke USDOT / Volpe Center
10:25 AM	Previous Workshop Recap, Moving Forward, Testing, and Clarifying points (308 KB PDF)	Stephen Mackey, Hadi Wassaf USDOT / Volpe Center
11:00 AM	GPS Adjacent Band Compatibility Assessment Topic Introductions (583 KB PDF)	Tom Stansell USDOT / Volpe Center Consultant
11:30 AM	Feedback on GPS Adjacent Band Compatibility Assessment Implementation	Geoff Stearn

	Plan (225 KB PDF)	LightSquared
12:00 PM	Lunch	All
1:00 PM	Garmin GPS Receiver Use Case information (3,346 KB PDF)	John Foley Garmin
1:30 AM	Trimble Use Case Information (5,140 KB PDF)	Kurt Zimmerman Trimble
2:00 PM	How GNSS Enables Precision Farming (995 KB PDF)	Mark Rentz John Deere
2:30 PM	Break	All
3:00 PM	Dense-Device Adjacent Band Compatibility Use Cases (Part I) – Part II at Future Workshop (1,138KB PDF)	Rich Lee, Chris Kurby Greenwood Telecommunications
3:30 PM	Applicable Testing and Associated Challenges (187 KB PDF)	Sandy Kennedy NovAtel Inc.
4:00 PM	Open Discussion	All
5:00 PM	Adjourn	All

FCC Jammer Enforcement

Background

The Communications Act's Jammer Prohibition

- **Legal Framework**
  - Broad Statutory Prohibition: The Communications Act prohibits the operation, manufacture, importation, marketing, and sale of equipment designed to block, jam, or otherwise interfere with authorized radio communications (e.g., GPS, cell phone, Wi-Fi, and radar communications).
  - Each violation of the jamming prohibition can lead to substantial monetary penalties (up to $122,500 for any single act), seizure of the illegal jammer, and criminal sanctions including imprisonment.
- **FCC Headquarters & Engineering Expertise in the Field**
  - Performs market surveillance, monitors jammer complaint intake, and conducts investigations
  - 24 offices across the country with engineers and other technical staff; primary mission is interference resolution
- **Nefarious Jammer Use Limited**
  - Still comparatively rare and small scale (based on what we see in incoming complaints and in the Field)
  - Disabling car alarms and wireless burglar alarm systems; blocking tracking of stolen cars
  - Some complaints about GPS jammers

Wireless Broadband

There is *massive, urgent demand for radio frequency spectrum*

- Smartphones, tablets and other mobile devices that connect to the Internet contain *radio transceivers* and require radio frequency spectrum access

What is prompting the demand?

- Companies and providers that stand to make billions of dollars on wireless broadband industry
- Government and other entities who see wireless broadband as an engine for employment and economic growth
- End users who want better, faster service

Commercial devices connected to mobile networks
2014 - estimated 5 Billion ---------- 2020 – estimated 50 Billion
Report to the President – Realizing the Full Potential of Government-Held Spectrum To Spur Economic Growth
President's Council of Advisors on Science and Technology July 2012

Revised Spectrum Bands

Table 2-1 Federal and Shared Spectrum Bands Under Investigation		
Frequency Band** (MHz)**	**Amount (megahertz)**	**Current allocation/usage**
406.1-420**	13.9	Federal
1300-1390**	90	Federal
1675-1710*	35	Federal/non-federal shared
1755-1780***	25	Federal
1780-1850***	70	Federal
2700-2900**	200	Federal
2900-3100	200	Federal/non-federal shared
3100-3500	400	Federal/non-federal shared
3500-3650*	150	Federal
4200-4400** [4200-4220 & 4380-4400]	200	Federal/non-federal shared
New 5350-5470	120	Federal/non-federal shared
New 5850-5925	75	Federal/non-federal shared
Total	1578.9	

* Parts of these bands recommended for reallocation in the *Fast Track Report*.

** Bands obligated by U.S.-Canada or U.S.-Mexico bilateral agreement(s) and will require international consideration if repurposed.

*** While the *1755-1850 MHz Report* considered the 1755-1850 MHz band in its entirety, the upcoming AWS-3 auction will include the 1755-1780 MHz portion of this band as described below.

**** The 2200-2290 MHz band has been removed from further consideration because studies indicate that high-density terrestrial mobile operations would cause significant interference to satellite receivers in this band.

All Disciplines
Water
DGPS/RTK
Hydrologic
Field data communications
Hazards/Seismic
Field data communications
Voice radio communications
OEI Administration Reston
Voice radio Communications

Water (GOES Downlink)
EROS (NOAA-18/19 & GOES)
1675-1710 MHz (receives data)
Hazards/Seismic
1710-1755 MHZ vacated
1755-1780 MHz FCC Auction 11/14/14
(estimate 2-3 years to vacate after auction)
1780-1850 MHz
UAS
1755-1780 MHz (little/no impact expected – working to replace DoD owned aircraft)

Natural Hazards
Acquires Satellite Radar Data (from non—US radar satellites)

Update Dropped 2200 – 2290 MHz Band (Landsat telemetry downlink)

USGS

Source: Fourth Interim Progress Report on the Ten-Year Plan and Timetable and Plan for Quantitative Assessments of Spectrum Usage – DOC June 2014

USGS Radio Advisory Committee – launched 8/11/2014

- **Initial key deliverables**
  - Risk and Cost Assessment
  - Review and Validate Radio Frequency inventory
  - Develop costs for USGS radio infrastructure upgrades
  - Coordinate with DOI IRAC representatives and the NTIA

CHECKS & BALANCES SPECTRUM MANAGEMENT SYSTEM