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**
- L5 1176.45 MHz
- L2 1227.6 MHz
- L1 1575.42 MHz

**GLONASS**
- Possible future signal

**GALILEO**
- E5a 1176.45 MHz
- E5b 1207.14 MHz
- E6 1278.75 MHz
- L1 1575.42 MHz

**QZSS**
- L5 1176.45 MHz
- L2 1227.6 MHz
- LEX 1278.75 MHz
- L1 1575.42 MHz

**Beidou/Compass**
- Possible future signal

**ITU Filings Here**
- L5 1176.45 MHz
- L2 1227.6 MHz
- E6 1278.75 MHz
- L1 1575.42 MHz

**IRNSS**
- Possible future signal in S-band
GPS Signal Modernization

Legacy Signals

Signals After Modernization

1176 MHz | 1227 MHz | 1575 MHz

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)
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 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.
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

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 AM</td>
<td>Introductions and Welcoming Remarks</td>
<td>Dr. Malina Hills, Vice President of Space Program Operations, Aerospace Corporation</td>
</tr>
<tr>
<td>10:15 AM</td>
<td>Initial Comments and Remarks</td>
<td>Karen Van Dyke USDOT / Volpe Center</td>
</tr>
<tr>
<td>10:25 AM</td>
<td>Previous Workshop Recap, Moving Forward, Testing, and Clarifying points (308 KB PDF)</td>
<td>Stephen Mackey, Hadi Wassaf USDOT / Volpe Center</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>GPS Adjacent Band Compatibility Assessment Topic Introductions (583 KB PDF)</td>
<td>Tom Stansell USDOT / Volpe Center Consultant</td>
</tr>
<tr>
<td>11:30 AM</td>
<td>Feedback on GPS Adjacent Band Compatibility Assessment Implementation</td>
<td>Geoff Stearn</td>
</tr>
<tr>
<td>Time</td>
<td>Plan</td>
<td>Resource Access</td>
</tr>
<tr>
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<td>-----------------</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Lunch</td>
<td>LightSquared All</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Garmin GPS Receiver Use Case Information (3,346 KB PDF)</td>
<td>John Foley Garmin</td>
</tr>
<tr>
<td>1:30 AM</td>
<td>Trimble Use Case Information (5,140 KB PDF)</td>
<td>Kurt Zimmerman Trimble</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>How GNSS Enables Precision Farming (995 KB PDF)</td>
<td>Mark Rentz John Deere</td>
</tr>
<tr>
<td>2:30 PM</td>
<td>Break</td>
<td>LightSquared All</td>
</tr>
<tr>
<td>3:00 PM</td>
<td>Dense-Device Adjacent Band Compatibility Use Cases (Part I) – Part II at Future Workshop (1,138KB PDF)</td>
<td>Rich Lee, Chris Kurby Greenwood Telecommunications</td>
</tr>
<tr>
<td>3:30 PM</td>
<td>Applicable Testing and Associated Challenges (187 KB PDF)</td>
<td>Sandy Kennedy NovAtel Inc.</td>
</tr>
<tr>
<td>4:00 PM</td>
<td>Open Discussion</td>
<td>LightSquared All</td>
</tr>
<tr>
<td>5:00 PM</td>
<td>Adjourn</td>
<td>LightSquared All</td>
</tr>
</tbody>
</table>
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

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*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

<table>
<thead>
<tr>
<th>Frequency Band (MHz)</th>
<th>Amount (megahertz)</th>
<th>Current allocation/usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>406.1-420**</td>
<td>13.9</td>
<td>Federal</td>
</tr>
<tr>
<td>1300-1390**</td>
<td>90</td>
<td>Federal</td>
</tr>
<tr>
<td>1675-1710**</td>
<td>35</td>
<td>Federal/non-federal shared</td>
</tr>
<tr>
<td>1755-1780***</td>
<td>25</td>
<td>Federal</td>
</tr>
<tr>
<td>1780-1850***</td>
<td>70</td>
<td>Federal</td>
</tr>
<tr>
<td>2700-2900**</td>
<td>200</td>
<td>Federal</td>
</tr>
<tr>
<td>2900-3100</td>
<td>200</td>
<td>Federal/non-federal shared</td>
</tr>
<tr>
<td>3100-3500</td>
<td>400</td>
<td>Federal/non-federal shared</td>
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<tr>
<td>3500-3650</td>
<td>150</td>
<td>Federal</td>
</tr>
<tr>
<td>4200-4400**</td>
<td>200</td>
<td>Federal/non-federal shared</td>
</tr>
<tr>
<td>[4200-4220 &amp; 4380-4400]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5350-5470</td>
<td>120</td>
<td>Federal/non-federal shared</td>
</tr>
<tr>
<td>5850-5925</td>
<td>75</td>
<td>Federal/non-federal shared</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1578.9</td>
<td></td>
</tr>
</tbody>
</table>

* 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 *1755-1830 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.

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**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)

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**Update**

Dropped 2200 – 2290 MHz Band (Landsat telemetry downlink)

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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

COMMUNICATIONS ACT OF 1934

NTIA
(On behalf of President)
- National Defense
- Law Enforcement & Security
- Transportation
- Resource Mgt Control
- Emergencies
- Other Services

FCC
(Independent Agency)
- Business
- State & Local
- Entertainment
- Commercial
- Private

INTERDEPARTMENT RADIO ADVISORY COMMITTEE (IRAC)
20 Govt Departments/Agencies as Members
NTIA Chairs IRAC & Subcommittees

COORDINATION
ADVISORY
LIAISON