Status Report: LightSquared/GPS Interference Issue

for the
National Geospatial Advisory Committee
Shepherdstown, WV
October 4, 2011

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Senior Advisor
Department of the Interior
National Coordination Office
Outline

• U.S. Space-Based PNT Organization
  – National Space-Based PNT Advisory Board
• U.S. Space-Based PNT Policy
• LightSquared Interference Issue
• Questions
U.S. Space-Based PNT Organizational Structure

WHITE HOUSE

NATIONAL EXECUTIVE COMMITTEE FOR SPACE-BASED PNT

Executive Steering Group
Co-Chairs: Defense, Transportation

NATIONAL COORDINATION OFFICE

Host: Commerce

ADVISORY BOARD
Sponsor: NASA

Defense
Transportation
State

Interior

Agriculture
Commerce
Homeland Security
Joint Chiefs of Staff
NASA

GPS International Working Group
Chair: State

Natl. PNT Engineering Forum (NPEF)
Co-Chairs: Defense, Transportation

Information Coordination and Dissemination Team
Co-Chairs: DOT, STRAT

Ad Hoc Working Groups
National Space-Based PNT Advisory Board

- Provides independent advice and recommendations on PNT
- 25 members (including 5 international members)
  - Co-chaired by Dr. James Schlesinger & Dr. Brad Parkinson
  - Gov. Jim Geringer New Member (2011) – Known to many in Geospatial Community
U.S. GPS Policy History

- 1983: President announces civilian access to GPS following KAL 007
- 1996: First U.S. GPS Policy establishes joint civil/military management
- 1997: U.S. law provides civil GPS access free of direct user fees
- 2004: President issues U.S. Policy on Space-Based PNT
- 2004: Agreement signed on GPS-Galileo Cooperation
- 2010: New National Space Policy provides high-level PNT guidance
  
  Maintain Leadership in the service, provision, and use of GNSS
  
  - detect and mitigate harmful interference

Aside: Broadband Policy Memo
2010: “Unleashing the Wireless Broadband Revolution”
What is LightSquared?

• New Telecom company formed Mid 2010
  – Formerly SkyTerra
  – FCC approved SkyTerra transfer order Mar 2010
• Company formed to create a nationwide 4G LTE (Long Term Evolution) open wireless broadband network
• First wholesale-only broadband network
• Intends to provide coverage to 92% of USA by 2015
• Key Asset
  – Mobile Satellite Service/Ancillary Terrestrial Component license for 1525–1559 MHz; 1626.5-1660.5 MHz
LightSquared Interference to GPS

• 26 Jan 2011: FCC Waiver to LightSquared (LSQ) for a Terrestrial Broadband in Mobile Satellite Service Spectrum adjacent to Spectrum used by GPS
  – FCC has condition on Waiver that harmful interference concerns to GPS be resolved
  – Technical Working Group (TWG) to examine interference issues

• Testing Shows Widespread Harmful Interference to GPS devices (NPEF, RTCA, TWG)

• 30 June: LSQ submits TWG Report and New Plan to FCC

• FCC sought comments until 15 August

• 9 Sept: NTIA Requests further testing by NPEF

• 13 Sept: FCC Says Additional Tests are Necessary
Illustration of Concerns with LightSquared

Situation before LightSquared

low power (on Earth) satcom emissions

1525 1559 1575 1610

L 1

GLONASS

Situation with LightSquared

LSQ base station emissions

gnss receiver filter response

low power (on Earth) satcom emissions

1525 1559 1575 1610

L 1

GLONASS
LightSquared Spectrum Plans

- L Band Satellite Downlink (34 MHz)
- RNSS band (GPS, 51 MHz)
- LTE (10)
- LTE (5)
- L Band Satellite (Uplink)
- Aeronautical Telemetry
- Aeronautical Radio navigation/Satellite (GPS, 51MHz)
- Big LEO (Uplink)
- L Band Satellite (Uplink)

Phase 0/1
- LTE (5)
  - 1526.3
  - 1531.3
  - 1550.2
  - 1555.2

Phase 2
- LTE (10)
  - 1526
  - 1536
  - 1545.2
  - 1555.2

1575.42 MHz
16.42 MHz
9.2
3.8
Upper L Band Spectrum for Global Navigation Satellite Systems

GPS
GLONASS
COMPASS
GALILEO
QZSS

Frequency (MHz)

1559 1575.42 1610
DOI Responses to LSQ Issue

• Dec 16, 2010 – DOI Raised LightSquared GPS interference concern at the NCO (email from FCC to the Federal Geodetic Control Subcommittee)

• Jan 3, 2011 – DOI Letter to NTIA: Interference issues should be investigated before a waiver is granted

• July 7 – DOI Impact Memo to NTIA: GPS is vitally important. DOI replacement costs estimated at $250-500 Million

• August 8 – DOI Position Letter from Deputy Secretary Hayes to NTIA: Do not approve LSQ plan. More testing on Low 10 MHz is needed.
DOI responses to LSQ issue

- Sept 9– Responded to NTIA request for GPS High Precision and Timing receiver inventory

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<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>High Precision</td>
<td>6,050</td>
</tr>
<tr>
<td>Timing</td>
<td>14,020</td>
</tr>
<tr>
<td>Specialized</td>
<td>170</td>
</tr>
<tr>
<td>Total</td>
<td>20,240</td>
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</table>
• Survey grade GPS is a critical component of our every-day work

• Invested over $200,000 in the past 5 years

• GPS made it possible for us to accomplish many jobs in a large geographic area

• GPS is our ‘bread and butter’, and our livelihood

• Quite alarmed

• The power belted out is simply incompatible with low power GPS

• Our DOI units, and hundreds of thousands just like them, could be rendered totally useless!
Congressional Hearings

• 23 June: House Transportation and Infrastructure Committee
• 8 Sept: House Science Committee
  – David Applegate DOI/USGS Testified
• 15 Sept: House Armed Services Committee, Strategic Forces Subcommittee
• More Hearings Likely

Note: Several different bills introduced in 2011 include language related to the FCC's authorization of a terrestrial broadband network that could interfere with GPS applications.
New NPEF Testing

• Targeted Testing
  – Navigation/Cellular Devices
  – Low 10 MHz
  – Testing facilities are scheduled /Planning underway
  – Hand set (LSQ Cell Phone) simulation to be included
  – Completion end of November/early December

• Testing is open for participation
  – DOI is making plans to participate in the Testing
  – Collaborating/pooling resources with USDA

• Anticipate additional testing for High Precision and Timing Receivers in early 2012
Where to get more information?

www.pnt.gov/interference/lightsquared/

GPS Tracker for Policy Makers (Monthly)
http://www.pnt.gov/congress/newsletter/
Questions?

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Back-ups

Just in Case
June 2010 Space Policy

• Maintain Leadership in the service, provision, and use of GNSS
  – Provide civil GPS service, free of direct user charges
  – Foreign PNT services may be used to complement GPS
  – Encourage Global compatibility and interoperability with GPS
  – Support International Activities to detect and mitigate harmful interference
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<tbody>
<tr>
<td>Purpose</td>
<td>Provide Mobile Satellite-like services</td>
<td>Provide Mobile Satellite-like services</td>
<td>Provide terrestrial wideband internet access</td>
</tr>
<tr>
<td>Coverage</td>
<td>Ancillary (indoors, urban canyons, etc)</td>
<td>Ancillary (indoors, urban canyons, etc)</td>
<td>Everywhere</td>
</tr>
<tr>
<td>Handsets</td>
<td>Dual mode satellite-terrestrial only</td>
<td>Dual mode satellite-terrestrial only</td>
<td>Dual mode or terrestrial-only</td>
</tr>
<tr>
<td>Number of towers allowed</td>
<td>1725 - 2415</td>
<td>No Limit</td>
<td>No Limit (40,000 planned)</td>
</tr>
<tr>
<td>Power per antenna sector</td>
<td>245 Watts</td>
<td>1500 Watts</td>
<td>Up to 15,000 Watts</td>
</tr>
<tr>
<td>Bandwidth per sector</td>
<td>600 kHz</td>
<td>600 kHz</td>
<td>20 MHz</td>
</tr>
</tbody>
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**FCC Commissioner Adelstein (Jan 2003):** “our decision should not allow a Mobile Satellite Services (MSS) system with an ancillary terrestrial component to evolve into a terrestrial system with an ancillary mobile satellite component”
LightSquared’s New Plan

• Re-order the phasing of their system. Initially deploying with the lower frequency of their two channels

• Reduce their power to a maximum of roughly 1500 watts per tower for initial deployment.

• “Standstill” for operating their second, higher frequency channel.
## TWG test results Summarized

<table>
<thead>
<tr>
<th>Sub-Team</th>
<th>Impact as planned</th>
<th>Mitigation</th>
<th>10 MHz lower spectrum only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>• Incompatible</td>
<td>• Filters not available to test</td>
<td>• Lower 5 Mhz likely would be compatible</td>
</tr>
<tr>
<td></td>
<td>• Complete Loss</td>
<td>• Receiver modification takes a long time</td>
<td>• Lower 10 Mhz needs further study</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shift to a different frequency would eliminate all concerns</td>
<td></td>
</tr>
<tr>
<td>Cellular</td>
<td>• Causes GPS failure</td>
<td>• Not possible</td>
<td>• Within grasp</td>
</tr>
<tr>
<td></td>
<td>• Significant number of devices impacted</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• LSQ may not be able to operate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Location &amp;</td>
<td>• Widespread Harmful Interference</td>
<td>• Filters do not exist</td>
<td>• Many devices still impacted</td>
</tr>
<tr>
<td>Navigation</td>
<td>• Safety of life must be preserved</td>
<td>• Only option is to shift to a different frequency</td>
<td>• LSQ questions these results</td>
</tr>
<tr>
<td></td>
<td>• Positional accuracy degrades</td>
<td></td>
<td>• Two points of view about what constitutes Harmful Interference.</td>
</tr>
<tr>
<td></td>
<td>• LSQ—operation in upper band of spectrum not viable</td>
<td></td>
<td>• LSQ favors a more probabilistic approach based on user experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• LSQ—data shows 10 Mhz low is a viable option</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• LSQ—filters will work</td>
</tr>
</tbody>
</table>
## TWG test results Summarized (continued)

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<th>Mitigation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>High Precision, Timing, &amp; Networks</td>
<td>- Harmful interference over long ranges&lt;br&gt;- Harmful co-channel interference (Starfire and Omni Star—private GPS augmentation services)&lt;br&gt;- LSQ handsets operated close (1m) to GPS device causes harmful interference&lt;br&gt;- Interference to GNSS and WAAS&lt;br&gt;- Good precision measurements require greater receiver band width</td>
<td>- Nothing Feasible&lt;br&gt;- Timing only, if LSQ restricted to high or low part of band&lt;br&gt;- Does not foresee any possibility that wide band GPS receivers would be compatible with LSQ signals&lt;br&gt;- Different frequency for terrestrial LSQ&lt;br&gt;- LSQ—receiver design at fault and causes overload&lt;br&gt;- Filtering option problematic&lt;br&gt;- LSQ—why won’t filtering work? No technical and operational obstacles (especially lower 10Mhz)</td>
<td>- Harmful Interference&lt;br&gt;- LSQ—Timing receivers performed well&lt;br&gt;- LSQ—Receiver side mitigation needs further work, options appear viable and need to be worked jointly with GPS community&lt;br&gt;- LSQ—questions what constitutes Harmful Interference&lt;br&gt;- LSQ—worst case test approach exaggerates interference, more probabilistic approach needed</td>
</tr>
<tr>
<td>Space Receivers</td>
<td>- Harmful Interference</td>
<td>- Not possible to mitigate receivers in space</td>
<td>- Harmful Interference&lt;br&gt;- Needs further study, options not fully tested</td>
</tr>
</tbody>
</table>
Upper L Band Spectrum for Global Navigation Satellite Systems
International Concerns on LightSquared: Galileo

• “Deep Concerns”
• “Considerable potential to cause harmful interference to Galileo”
• “Grave threat to providing Galileo service covering US”
• Galileo interoperable with GPS
• No Galileo receivers tested