



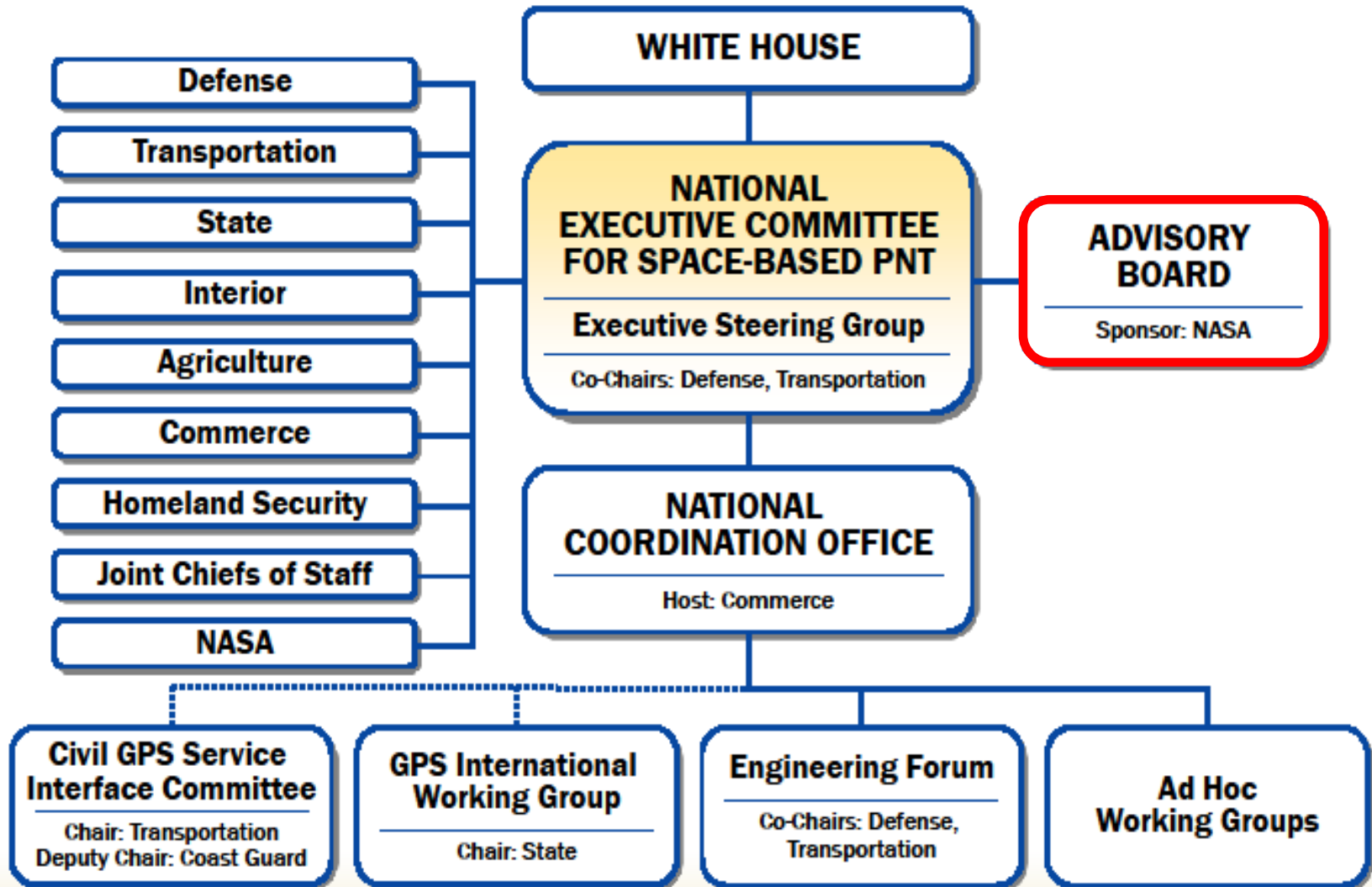
***Update from the United States
Space-Based Positioning, Navigation,
and Timing Advisory Board***

*John W. Betz, PhD
PNTAB Member*

*Presented to ICG-12, Kyoto, Japan
December 2017*



PNTAB Established by 2004 U.S. Presidential Decision Directive on Space-Based PNT





PNTAB Overview





PNTAB Overview



- **Charter: provide independent advice to the U.S. government on GPS-related policy, planning, program management, and funding profiles in relation to the current state of national and international satellite navigation services**
- **Membership: up to 25 members representing U.S. industry, academia, and international organizations**
- **Biannual meetings, each one and one-half days of open (public) meetings**
- **Focus on *PTA Program***
 - **Protect the radio spectrum from interference that degrades GNSS use**
 - **Toughen satnav receivers against natural and human interference**
 - **Augment with additional PNT sources and techniques**



Highlights of November 2017 PNTAB Meeting



- GPS program status
- Timing criticality and upcoming GPS week rollover
- Societal benefits from GNSS: disaster mitigation, weather forecasting using radio occultation, remote sensing using reflectometry
- Economic impacts in U.K. to loss of GNSS
- GNSS protection
- Protecting critical GPS infrastructure in the U.S.
- Spectrum: LTE plans, criteria for adjacent band interference, test results
- Reports from representatives: GNSS issues at the United Nations, science issues in the International GNSS Service, international standards impacts, Arabian regional update, European regional update



Protect: Spectrum Issues



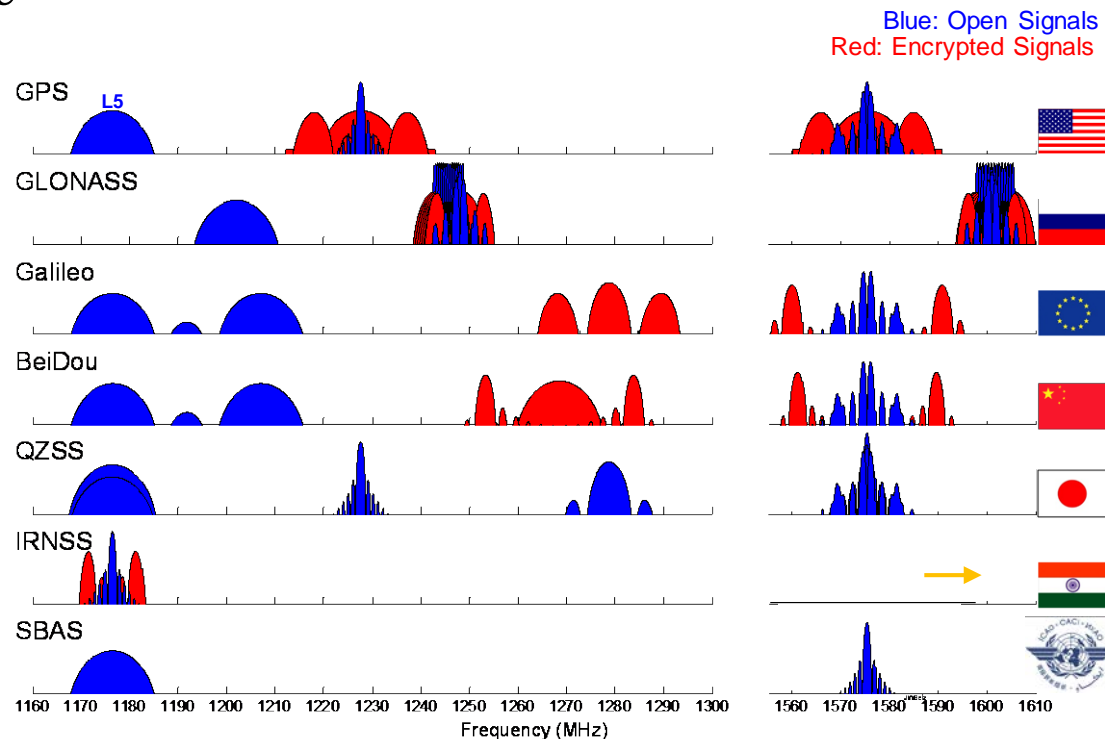
- **Interference can limit continued and increased benefits from GNSS**
 - Adjacent band interference
 - In-band pseudolites
 - Personal privacy jammers
- **1 dB Interference Protection**
Criterion for effects of adjacent band interference on current receivers
- **Support for ICG's activities on Interference Detection and Mitigation**



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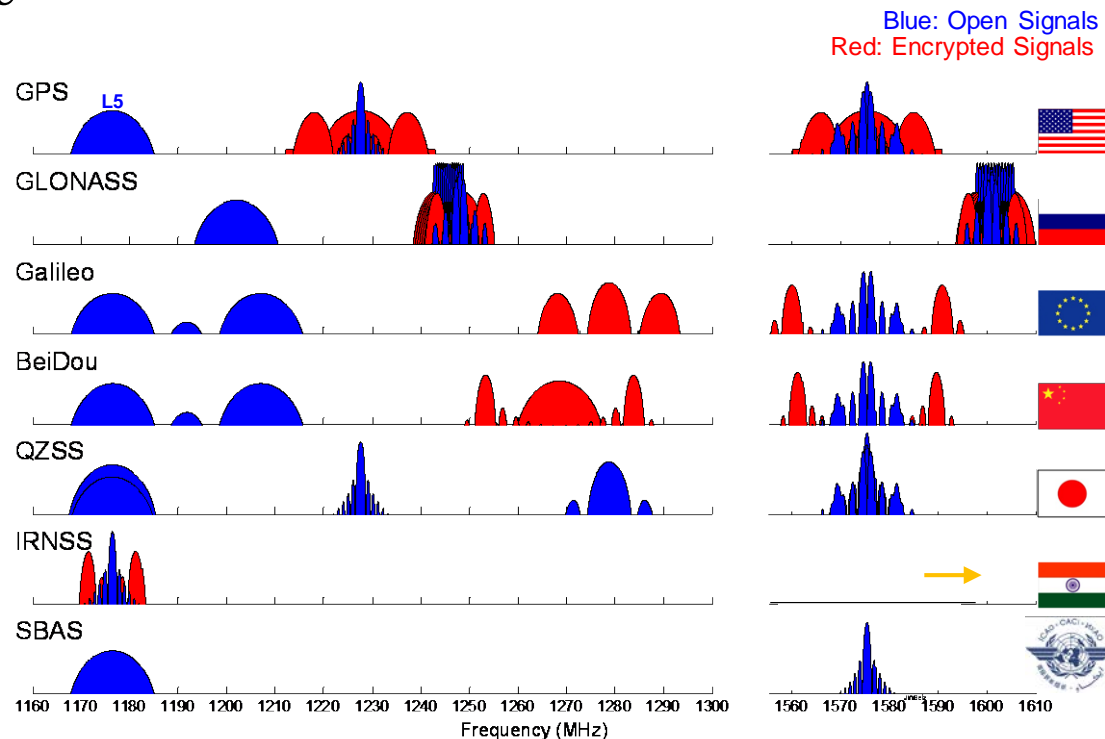




Protect: Spectrum Issues



- Interference can limit continued and increased benefits from GNSS
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 - In-band pseudolites
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- 1 dB Interference Protection Criterion for effects of adjacent band interference on current receivers
- Support for ICG's activities on Interference Detection and Mitigation
- Should the GNSS community develop a proposed/preferred plan for L-band spectrum use?



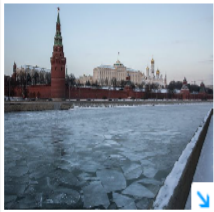


First Step in Toughen: “Competent Receivers”



Mysterious GPS glitch telling ships they're parked at airport may be anti-drone measure

Elizabeth Weise, USATODAY Published 1:41 p.m. ET Sept. 26, 2017 | Updated 3:03 p.m. ET Oct. 3, 2017



(Photo: Sergei Ilnitky, EPA)

CONNECT TWEET LINKEDIN COMMENT 1 EMAIL MORE

SAN FRANCISCO — Researchers have discovered a disturbing pattern: dozens of ships whose GPS signals tell them they're on land — at an airport no less — even when they're far out to sea.

An investigation released last week by Washington D.C.-based Resilient Navigation and Timing

Foundation and Windward Ltd., a maritime data and analytics company, found multiple instances of so-called GPS spoofing in Russian waters.

As recently as last month, two vessels' GPS told them they were at Sochi Airport near the site of the 2014 Sochi Olympics, 12 miles away from the harbor where the vessels actually were.

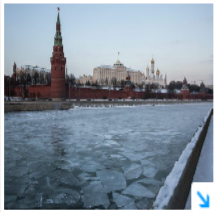


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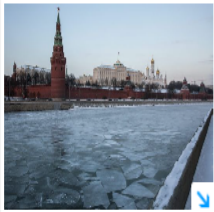


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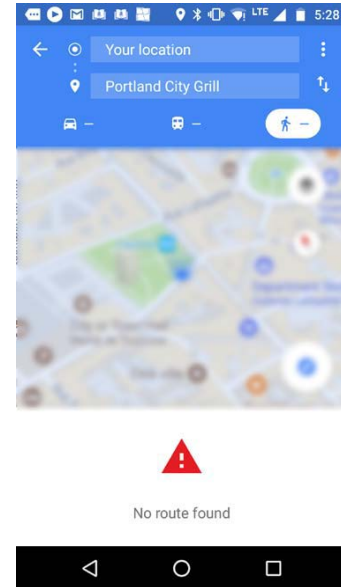
Spoofing Incident Report (Redacted)

An Illustration of Cascading Security Failure

An accidental GNSS spoofing event at ION GNSS+2017 leads to problems with cell phones

Logan Scott
10/3/2017

- Accidental spoofing at ION GNSS+ 2017
 - GPS simulator unintentionally radiating low power signals deep indoors
 - Some mobile devices reported location in Europe and date of 2014
 - Associated secondary problems with email and text messaging



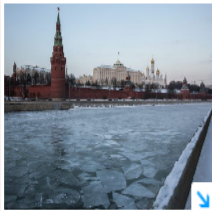


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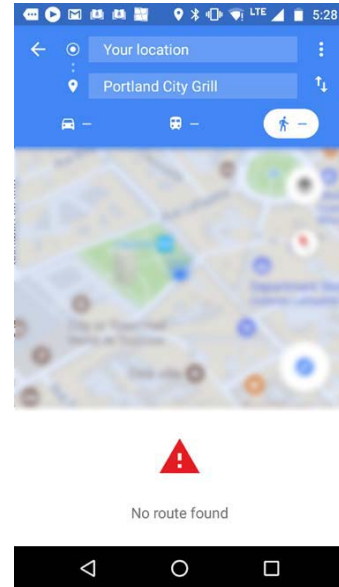
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• Are these receivers competent?

- Should maritime receivers on large vessels report position changes of 45 km in a few seconds, altitude 39 m under water, location on an airport runway?
- Should mobile devices report “time travel” from 2017 to 2014 and moving >8000 km in a few minutes?



Augment: Backup PNT Capabilities



- U.S. 2004 Presidential Decision Directive on space-based PNT calls for the Secretary of Transportation, in coordination with the Secretary of Homeland Security, to “develop, acquire, operate, and maintain backup position, navigation, and timing capabilities ...”



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- How best to back up PNT for diverse applications?
- Precision agriculture
- Earthmoving
- Construction other than earth moving
- Surveying
- Timing
- Air transportation
- Rail transportation
- Road transportation
- Maritime transportation
- Fleet vehicle telematics
- Consumer
- Non-vehicle location-based services
- Geographical information services other than surveying
- Open pit mining
- Forestry
- Health
- Education
- Weather, climate
- Science
- Space
- Emergency response
- Disaster assessment and relief
- ...



Take Aways



- PNTAB represents diverse interests to U.S. Government decisions on GPS
 - International members contribute needed global perspective
- More progress is needed toward Protect, Toughen, and Augment (PTA)
- Might other GNSS Service Providers sponsor similar advisory boards for addressing similar issues?
 - Protect, Toughen, Augment
 - Obtaining global perspectives on system decisions