

US DOT Developments on PNT Resiliency

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Cocoa Beach, FL

20 Nov 2019



U.S. Department of Transportation

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PNT Resiliency Policy

- **US Public Policy**

- National Security Presidential Directive 39, “Space-based Positioning, Navigation, and Timing Policy” places responsibility on DOT as the lead agency for all civil and commercial applications
- Presidential Policy Directive 21, “Critical Infrastructure Security and Resilience Policy” places responsibility jointly with DHS and DOT for civil and commercial applications

- **Space-based PNT Executive Committee**

- Spectrum protection has been the focus for the last 5+ years, taking up cybersecurity and complementary PNT
- PNT Advisory Board guidance: Protect Spectrum, Toughen Infrastructure and User Equipment, and Augment Services (so-called [PTA](#))

PNT Resiliency Initiatives

- **Department Collaborations**

- DOD/DHS/DOT GPS Backup Demonstration
- DOD/USAF Spectrum Protection (Adjacent Band, ITU, PRN assignments)
- DHS Best-practices Guide for Critical Infrastructure for [commercial entities](#)
- DHS Conformance Framework development as “Responsible Use of PNT Services” prep

- **DOT Initiatives**

- Modernized GNSS Open Signals and Specification
- Complementary PNT Services
 - Encoding new & improved standards, e.g. GNSS specifications, service level agreements
 - Government [investment](#) in infrastructure, National Timing Resiliency and Security Act of 2018
- User Equipment Guidelines and Standards
 - Transportation modal initiatives: FRA, MARAD, FAA, NHTSA/ITS-JPO

Taxonomy of PNT Resiliency Mechanisms

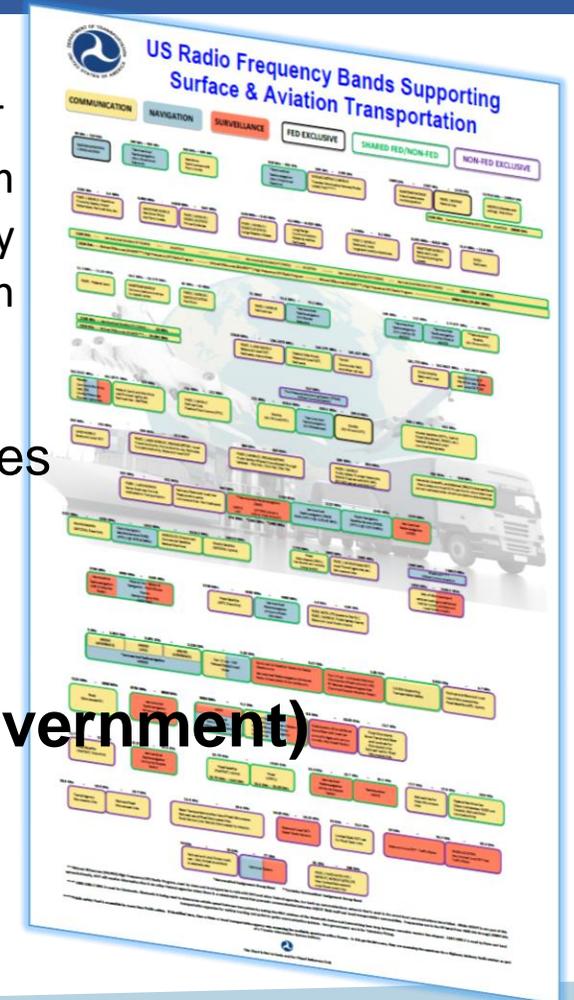
- **US Government Infrastructure Investment**

- Complementary PNT Services
- PNT Signal Authentication
 - Specifications and trust framework
 - In-band and out-of-band transmission
- Sponsoring of Standards Bodies Participation and Technology Initiatives
 - Nav: ICG, ICAO, IMO, RTCA, EUROCAE, SAE, etc.
 - Comm: 3GPP, V2X, etc.
 - Technology for monitoring, user notification, and threat detection/enforcement

- **End User Equipment Investment (Industry, Academia, Government)**

- Sensor Fusion, Clock, and Antenna Techniques
- Out-of-Band Data Channels for GNSS Assurance
- Diversity of Services and Adoption/Development of Standards

2019 DOT
Spectrum
Survey
Refresh



GPS Enterprise Baseline Activities

- GPS Enterprise Baseline Support
 - Boarded RFC-413 (ISM for ARAIM), Sep '19
 - Oversight on OCX implementation of CSM (RFC-067b) and PSICA Working Group
 - Re-invigorated AFSPC liaison support
 - Assisting navigation message and ranging authentication development
- Civil Signal Operational Capability IPT
 - Focus on modernized (civil) signal operational declarations
 - Coordinating L2C early-use initiative DOT
 - Leading on GPS Enterprise requirements (GPS IIIIF & OCX CDDs)
- GPS SPS PS draft 5th ed. & CMPS 3rd ed. redlines
- OCX Independent CSM Development (DoD and FAA TC partners)

ARAIM Standards Update for Aviation

- WG-C cooperating with RTCA and EUROCAE to develop MOPS material
 - Possible 2020 MOPS publication, likely to be deferred to 2022 publication cycle
 - Example FAA airborne algorithm (v3.1) provided to standards groups for review and consideration. Intent to publish on www.gps.gov.
 - Focus shifting to industry led activity through RTCA and EUROCAE with WG-C support
- WG-C also developing proposed ICAO SARPS for Service Providers
 - Draft requirements have been proposed and under discussion
 - Significant validation material still required, potential to follow SBAS message authentication
 - Process will derive requirements for GPS CNAV ISM (e.g. minimum transmission rate, ISM re-certification rate)

ARAIM FAA Prototyping and Testing

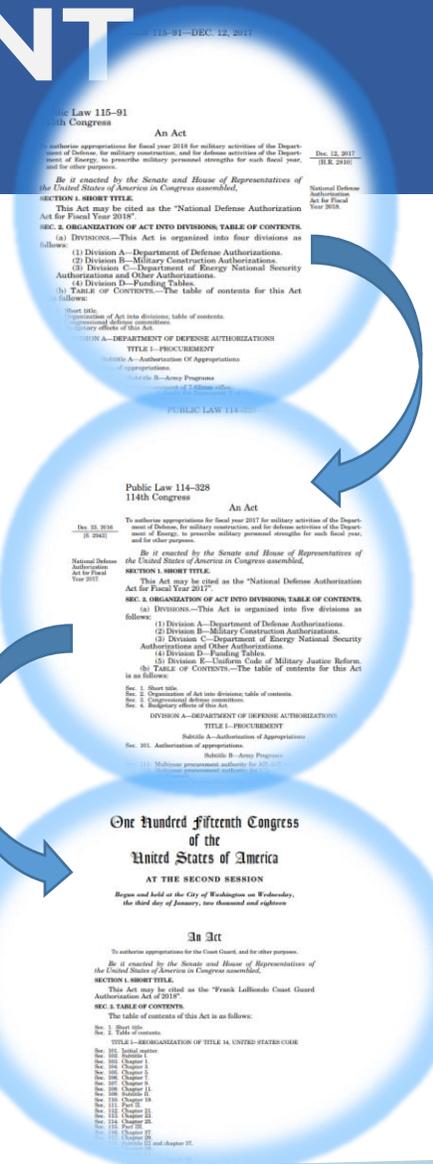
- Avionics
 - EU has multi-year program to develop avionics with multiple vendors
 - FAA planning market survey in FY20 to developing flight test platform with ARAIM function
- Integrity Status Message Generator (ISMG)
 - EU primary efforts conducted under ARTEX project
 - Prototype algorithms for ISM bounding. Results published in 2019 ION and ICAO papers.
 - US prototype implementations in FAATC tool suite
 - Test ISM results planned for publication Jul 2020
 - Methods evolving in support of standards validation and service provider commitments
- No immediate plan to prototype FAA-to-GPS ISM interface, tracking with GPS RFC-413

Related Civil Signal Coordination

- AFSPC/50th/2SOPS partnership on constellation management and monitoring needs
- Space-based PNT Executive Committee and Advisory Board input
- International Coordination at ICG, ICAO, IMO, and WG-C levels
- Forward-look and watch items
 - IFOR requirements traceability to the GPS Enterprise (GPS III F)
 - Achieving L5 suitability: operational declaration(s) and performance
 - GPS SPS Performance Standard 5th Ed publication
 - 2019 Federal Radionavigation Plan
 - L2C Early Use declaration process
 - Progress to L2C & L5 IOC/FOC

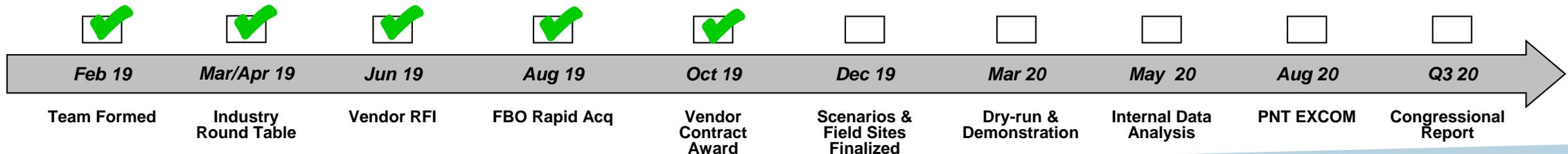
Congressional Motivation on Resilient PNT

- Sequential Legislation on Backup/Complementary PNT Service
 - Needs Established for PNT : **FY17 NDAA**
 - Demonstrate PNT Technologies: **FY18 NDAA (\$10M)**
 - Procure Alternate [to GPS] Timing System: **Frank LoBiondo Coast Guard Authorization Act of 2018 (No Appropriation, Amended 24 Jul 2019)**
- FY17 & FY18 NDAA joint responsibility for DOD/DHS/DOT
 - Appropriation through DOD to DHS & DOT
 - Joint reports on needs & technologies to congressional committees
- LoBiondo Act Places Procurement on DOT (P.L. 115-282, Sec. 514; 4 DEC 2018)



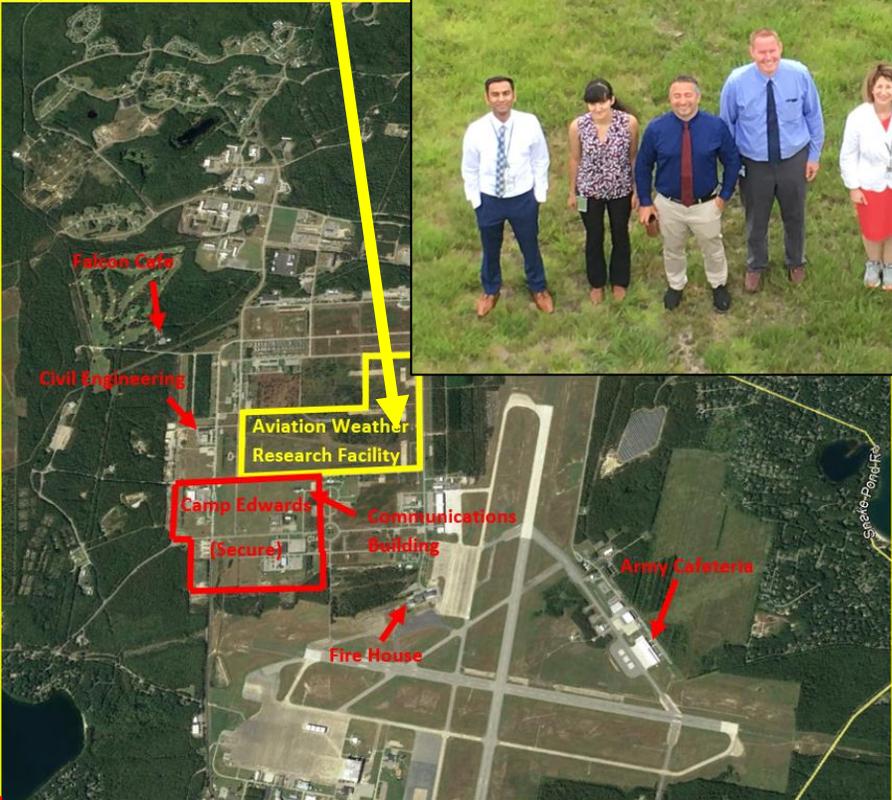
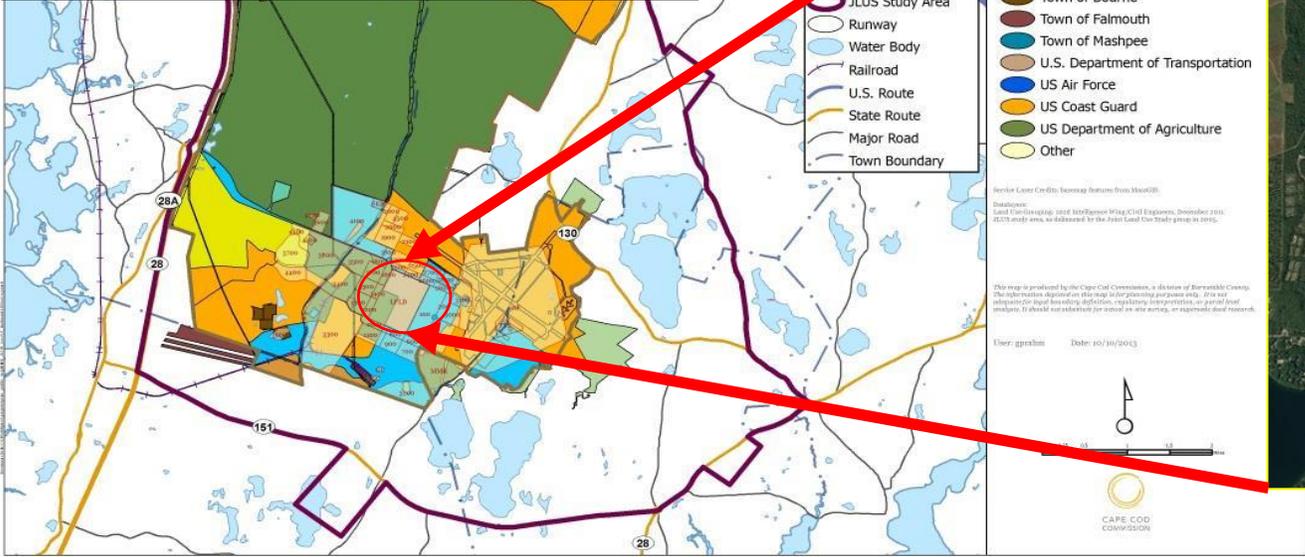
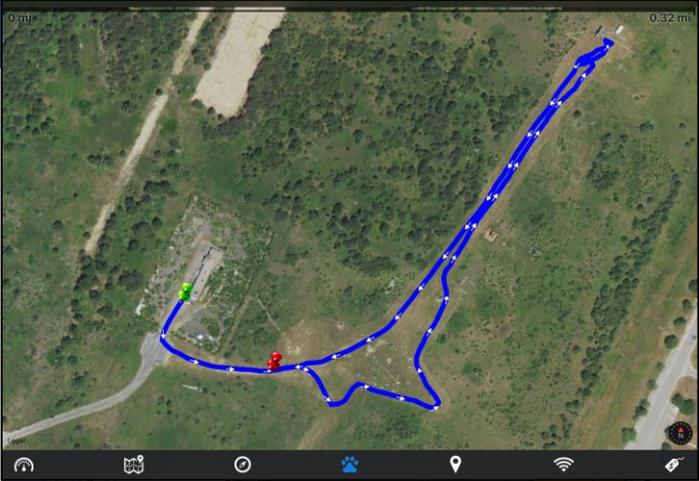
NDAA PNT Demonstration Work Plan

- Government Team: Nine organizations, five field sites, four test platforms, 28+ personnel
- Executed two acquisitions (govt support & PNT vendors), three field campaigns, preparing PNT demonstration report, and coordination with DOT Extended Pos/Nav
- Awarded PNT vendors (I I) with high TRL on rapid acquisition purchase orders
- Output products:
 - Demonstration performance report and recommendations to DOT leadership
 - Draft briefing for Space-based PNT Executive Committee



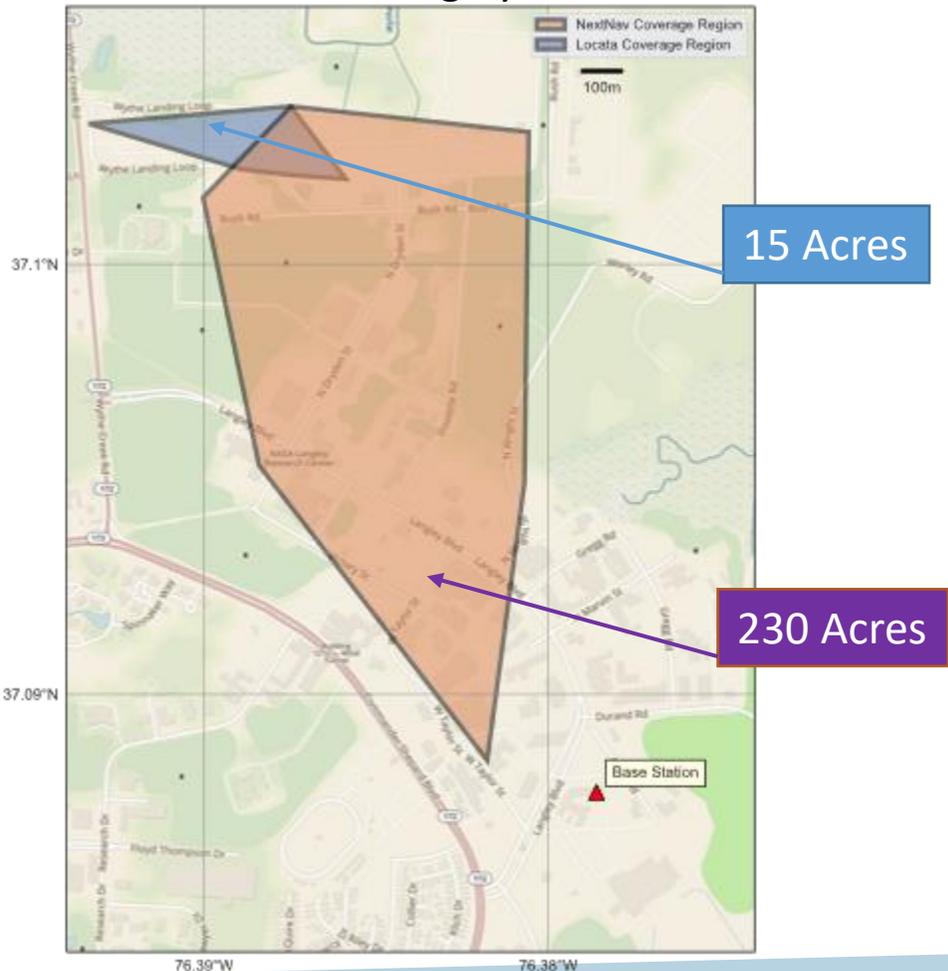
Complementary PNT Demo (JBCC)

150 Acres
Volpe Test Facility

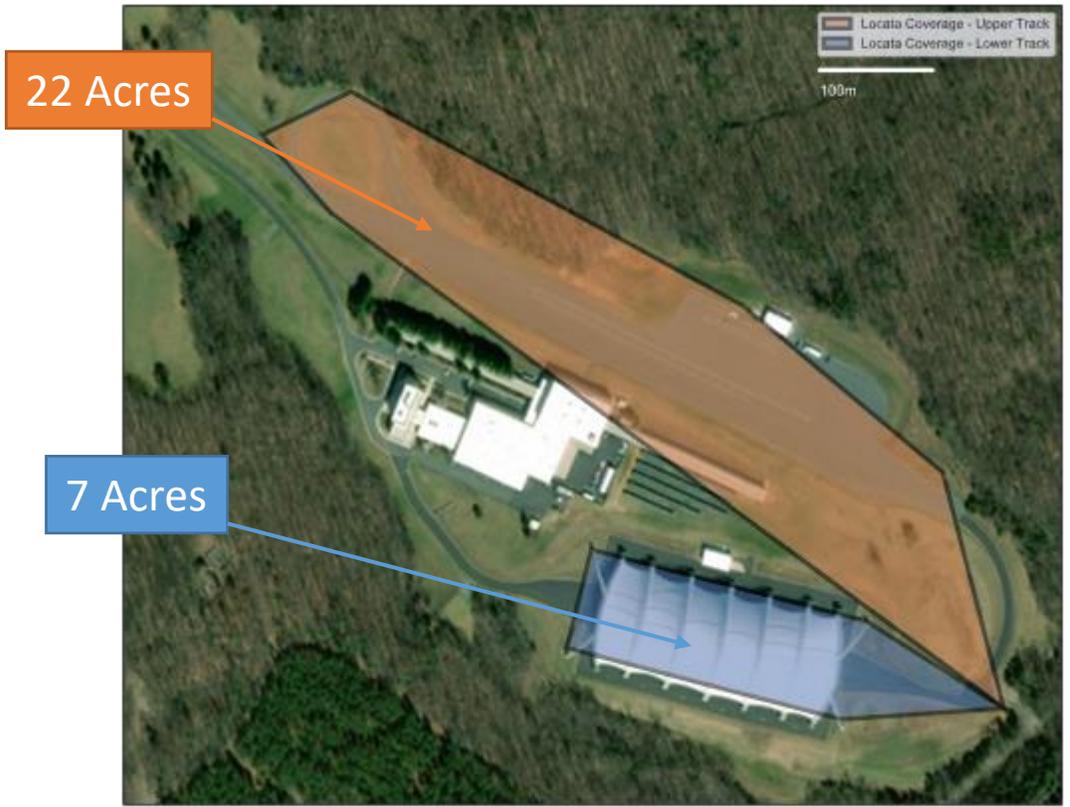


Complementary PNT Demo (LaRC & IIHS)

NASA Langley



IIHS Ruckersville



Example RF Transmitter (Fixed—Wildwood LSU)



Example RF Transmitter (Fixed—LaRC)



Example Terrestrial RF Transmitter (Portable)



Summary

- **Working the Core of PNT Resiliency**
 - GPS as the pillar of PNT: standards, performance, monitoring, authentication
 - DOT/FAA-AFSPC/SMC Integrated Product Team operational declarations
 - Tracking PNT Policy Developments
 - Supporting State Department on international and bi-lateral service provider coordination
- **Demonstrating Complementary PNT for Increased Resiliency**
 - Broad range of technologies across geospatial and spectrum diversity
 - Incorporating cross-departmental practices and guidance
 - Preparing decision framework for government investment in PNT

Questions?

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