US DOT Developments on PNT Resiliency

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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)

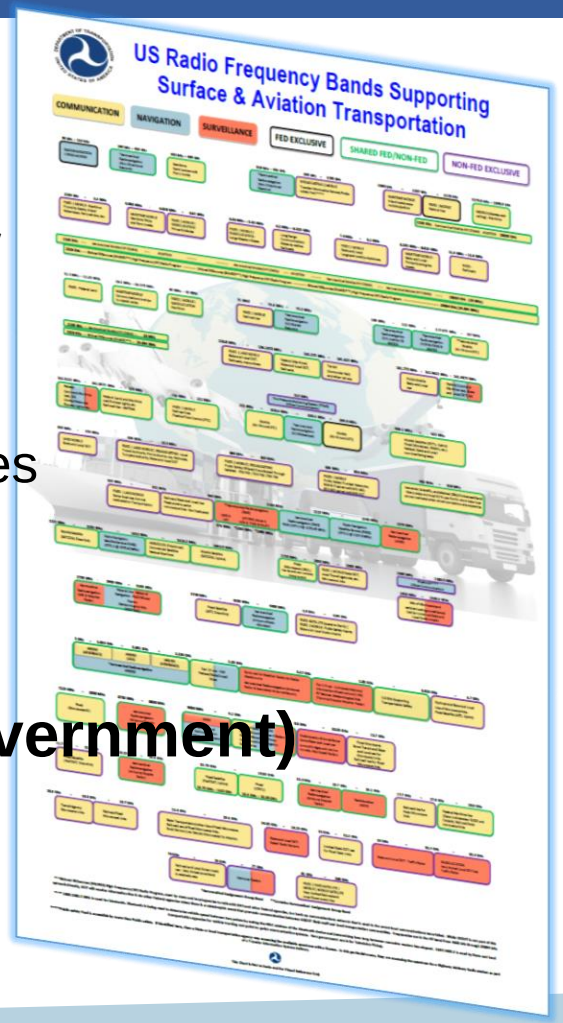
PNT Resiliency Initiatives

- **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



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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 IIIF & 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

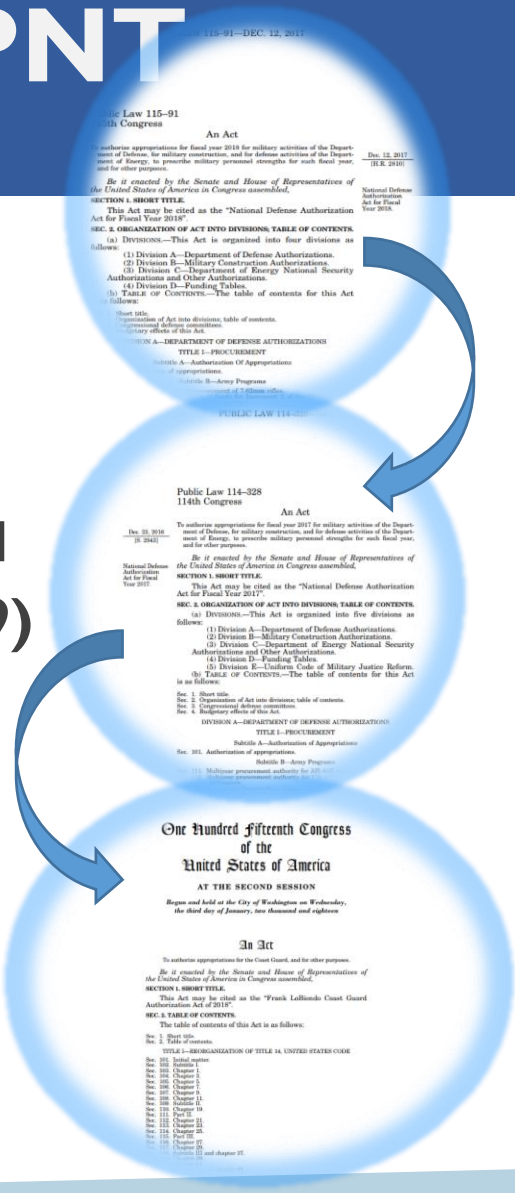
- Avionics
  - EU has multi-year program to develop avionics with multiple vendors
  - FAA planning market survey in FY20 to developing flight test platform with ARAIM function
- Integrity Status Message Generator (ISMG)
  - EU primary efforts conducted under ARTEX project
    - Prototype algorithms 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 committments
- 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 IIIF)
  - 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

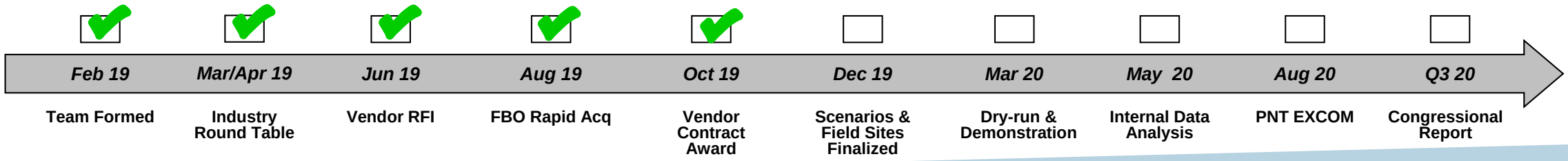
Congressional Motivation on Resilient PNT

- 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)

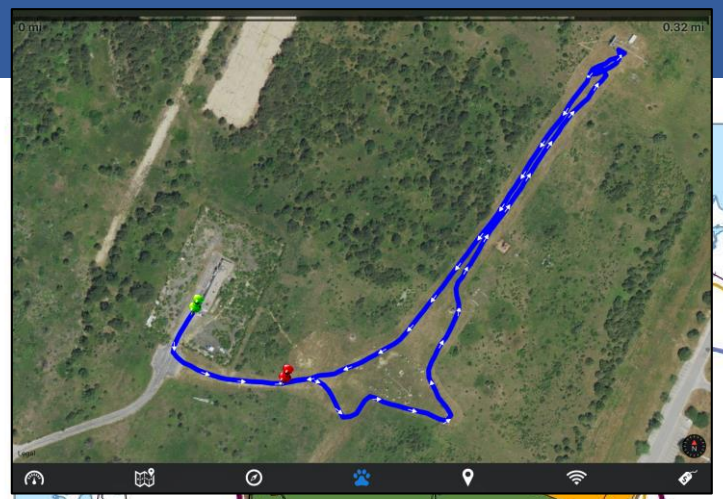

Public Law 115–91
115th Congress
An Act
Public Law 114–328
114th Congress
An Act
One Hundred Fifteenth Congress
of the
United States of America
AT THE SECOND SESSION
An Act

NDAA PNT Demonstration Work Plan

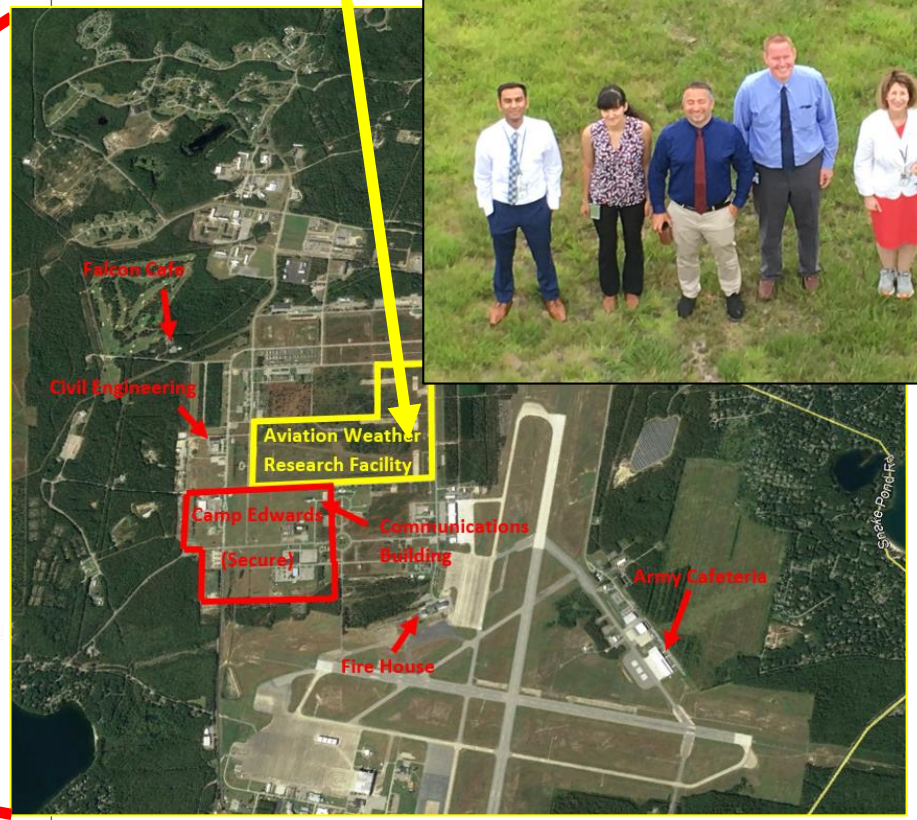
- Government Team: Nine organizations, five field sites, four test platforms, 28+ personnel
- Executed two acquisitions (govt support & PNT vendors), three field campaigns, preparing PNT demonstration report, and coordination with DOT Extended Pos/Nav
- Awarded PNT vendors (11) with high TRL on rapid 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



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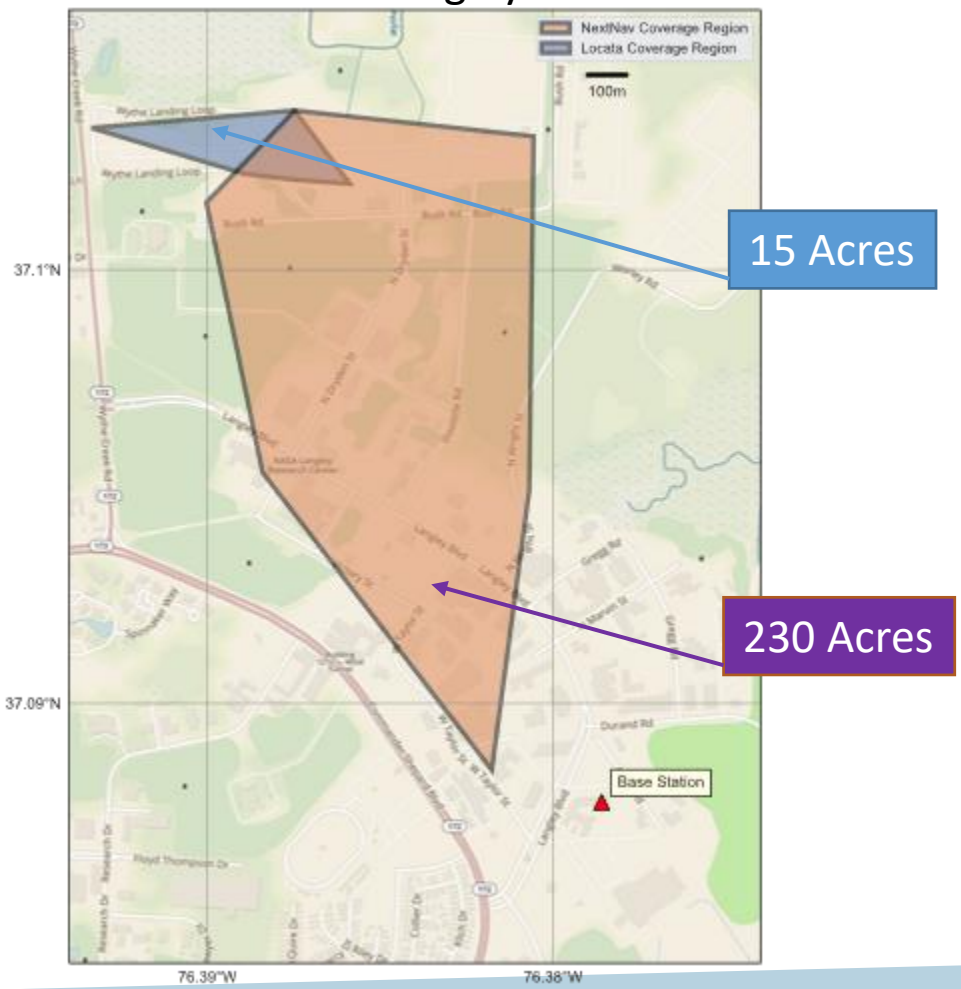
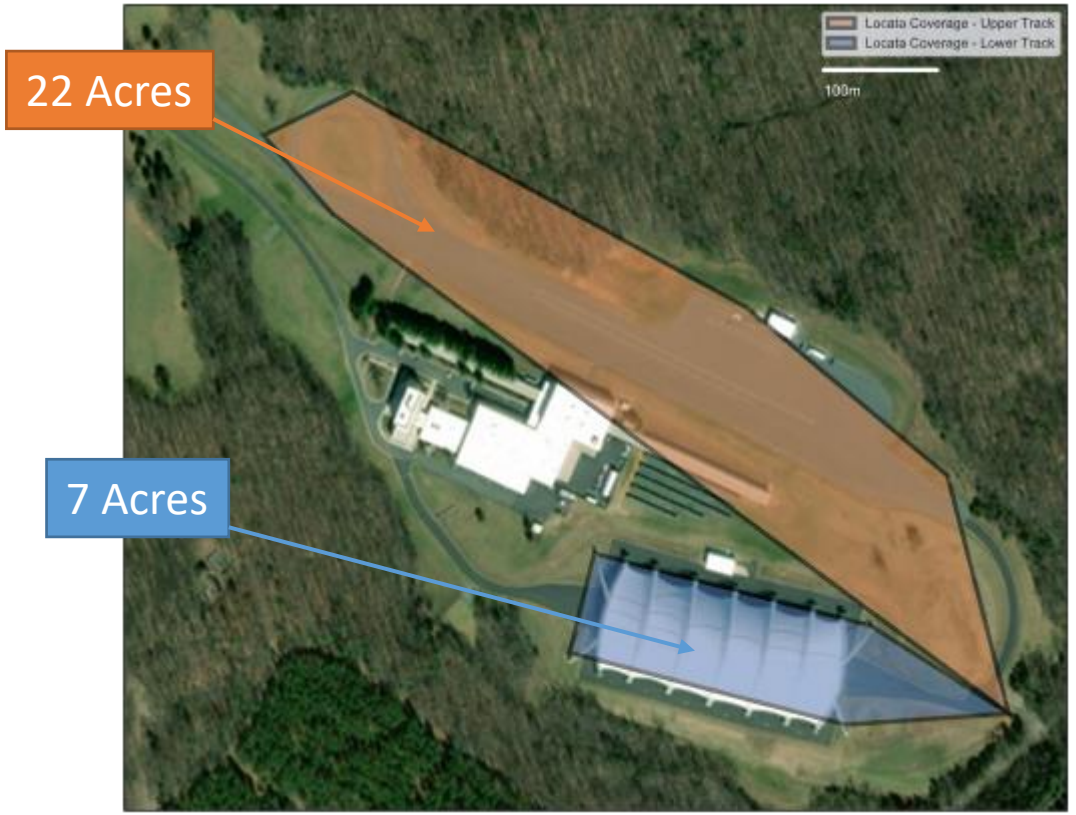
Complementary PNT Demo (LaRC & IIHS)

NASA Langley



IIHS Ruckersville



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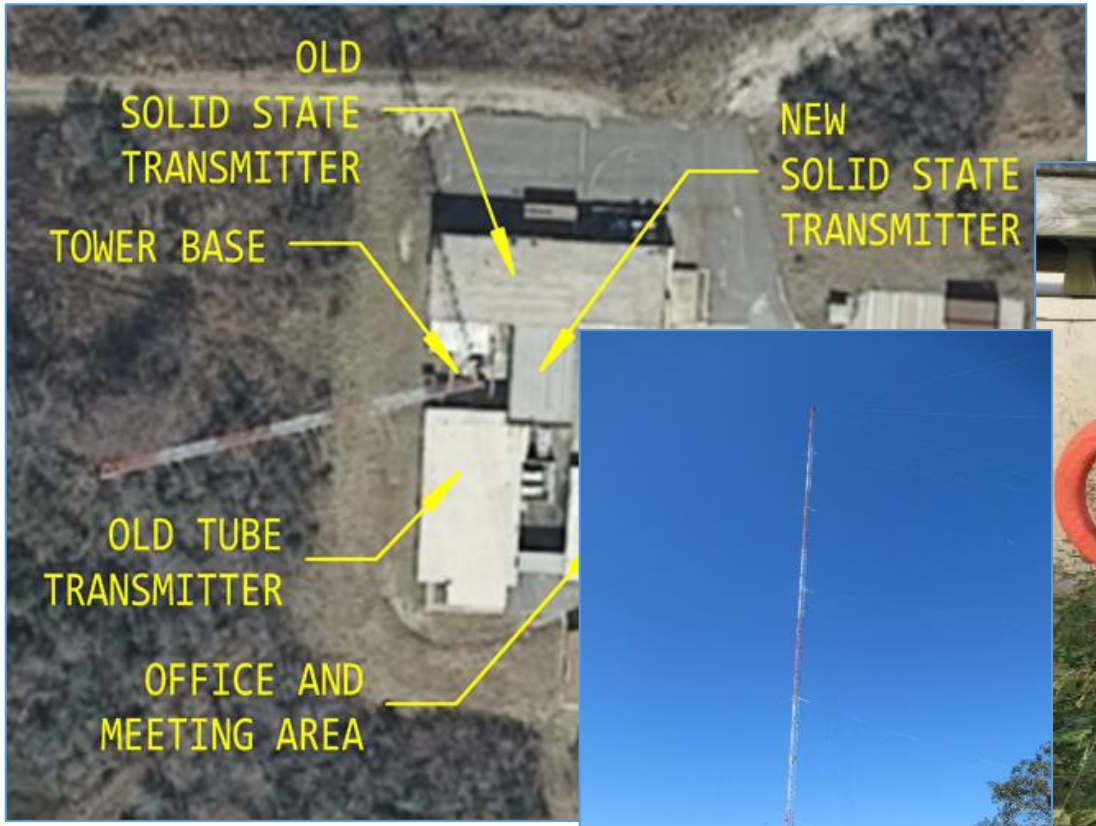
Example RF Transmitter (Fixed—Wildwood LSU)



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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