

# Resilient PNT for Transportation Applications

Virtual Workshop on Synchronization and Timing Systems

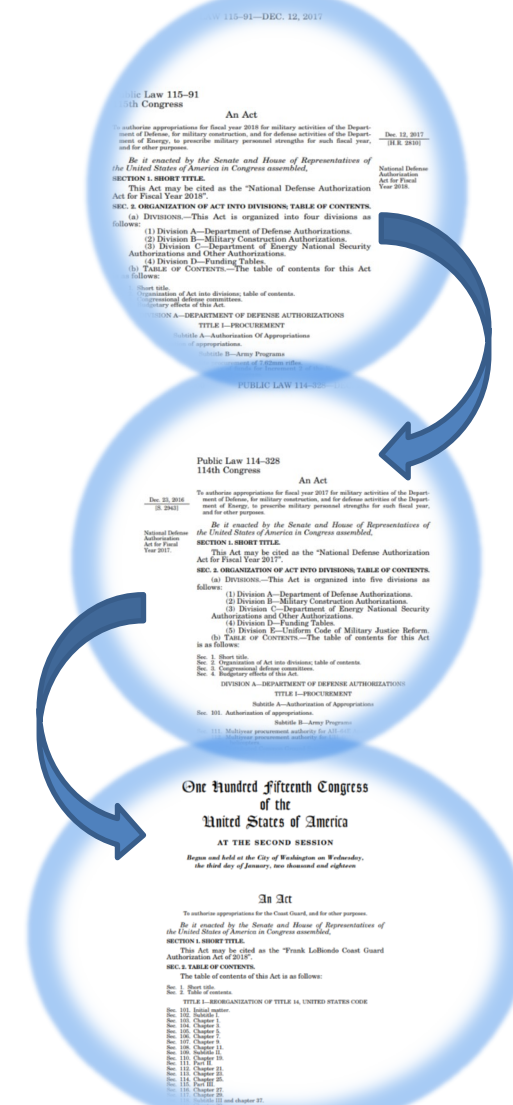
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May 20, 2020



# Congressional Motivation on GPS Backup and Complementary PNT Capability

- Sequential Legislation on Backup/Complementary PNT Service
  - Needs Established for PNT : **FY17 NDAA**
  - Demonstrate PNT Technologies: **FY18 NDAA**
  - Procure Alternate [to GPS] Timing System: **Frank LoBiondo Coast Guard Authorization Act/National Timing Resilience and Security Act (NTRSA) of 2018**
  - National Timing Resilience and Security Act Places Procurement on DOT



# GPS Backup Demonstration Overview

## High-level Demonstration Plan Developed Under FY18 NDAA

- Joint DOT/DHS/DOD congressional briefing given Nov 2018
  - Coordination and planning efforts presented
  - DOT had yet to receive funds, transportation demonstration concept presented
  - DOD legislative affairs drafted FY20 NDAA extension to Dec 2020
- DHS Science and Technology conducted timing and positioning demonstration
  - Dec 2018 at NASA Langley/Insurance Institute for Highway Safety (IIHS) Ruckersville, VA
  - Technologies demonstrated: Locata, NextNav, Satelles (those already available at Langley)
  - Results and interim report in process
- DOT Volpe Center funded to execute demonstration (Jan'19 - Dec '20)

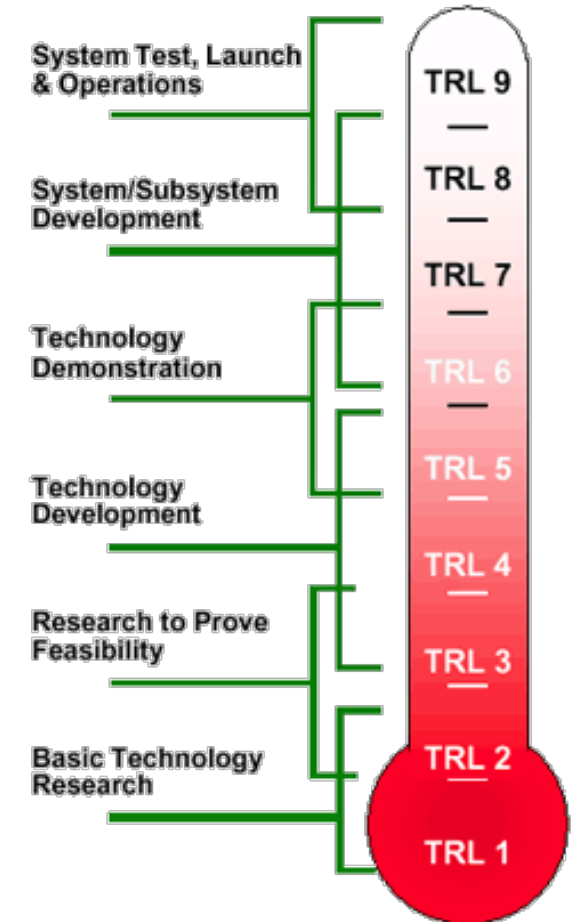
# NDAA GPS Backup Demonstration

## Demonstration Scope for FY18 NDAA

- Commercial services with a high Technical Readiness Level (TRL >6)
- Scenario based demonstration plan (agnostic of technology)
- Dynamic 2D/3D positioning, timing, varied service areas, and scenario durations
- Field teams across JBCC, NASA Langley, Wildwood, NJ, and FAA Tech Center

## Demonstration Schedule

- ✓ DOT sponsored technology vendor round tables, Mar & Apr 2019
- ✓ Request For Information (RFI) conducted, Jun 2019
- ✓ Vendor engagement and rapid acquisition process for demo support, Aug 2019
- ✓ Contract award to technology vendors, Oct 2019
- ✓ Demonstration(s) at FAA Tech Center, JBCC, NASA Langley, & Wildwood, NJ, Mar 2020
- National Space-Based PNT EXCOM Recommendations: Aug 2020
- FY18 NDAA Report [coordination with DHS/DOD] to Congress after interagency review



# DOT/Volpe Contracted Vendors



SKYHOOK°

**SEVEN**  
Solutions



*Satelles*



serco & ALION

**HELLEN**  
systems



# GPS Backup/Complementary PNT Demonstration

NASA Langley

Map Match

1

TRX

Terrestrial RF

2

NextNav, Skyhook

Satellite

1

Echo Ridge

Fiber Optic

2

OPNT & Seven Solutions

JBCC

Map Match

0

Terrestrial RF

4

Hellen Systems, UrsaNav, Serco, & Phasor Lab

Satellite

1

Satelles

Fiber Optic

0

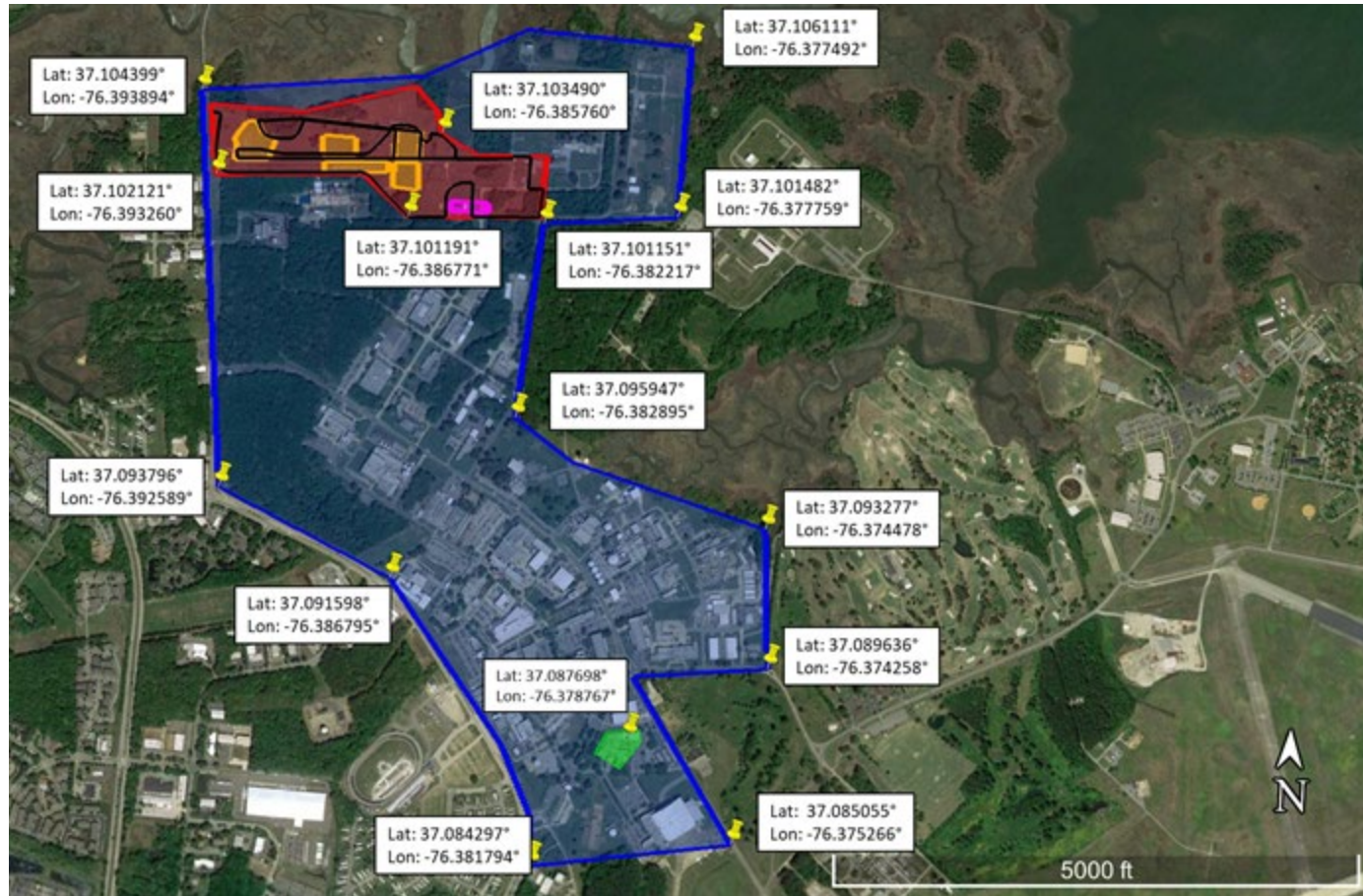


# Demonstration Plan Detail

				Technologies							Demo Platforms				
				In Situ	Terrestrial RF				Satellite	Fiber Optic	Fixed		Moving		
VIP Demo	day	start	end	Map Match	LF (Loran)	MF (R-mode)	VHF (passive)	WiFi (2.4 GHz)	L-Band (LEO)	PTP	Outdoor	Indoor	Static	2D (van)	3D (uas)
LaRC	13-Mar	9:00	16:00	x			x	x	x	x	x	x	x	x	x
JBCC	20-Mar	9:00	16:00		x	x		x	x		x	x	x	x	x
			Vendors	TRX	Hellen Systems	Serco	NextNav	PhasorLab	Echo Ridge	OPNT					
					UrsaNav			Skyhook	Satelles	Seven Solutions					

	GPS Backup Demonstration: Vendor Travel and Deliverables Schedule - Through Demonstration																						
Weeks from Award	2019									2020													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Week Start Date	4-Nov	11-Nov	18-Nov	25-Nov	2-Dec	9-Dec	16-Dec	23-Dec	30-Dec	6-Jan	13-Jan	20-Jan	27-Jan	3-Feb	10-Feb	17-Feb	24-Feb	2-Mar	9-Mar	16-Mar	23-Mar	30-Mar	
Demonstration Site Visits			*																				
Site Plan				★																			
UE Integration Verification				★	*																		
UE Hardware							★	*															
Vendor Technology Setup											*		★										
Dry Run															*		★						
Demonstration																			*		★		
*= Travel ★ = Deliverable	Date of Award = November 4, 2019																						

# NASA Langley Research Center Field Facility



- Black track used for static timing, static positioning, and dynamic positioning scenarios
- Orange areas used for static timing, static positioning, and dynamic UAS/3D positioning scenarios
- Magenta area (hanger) used for indoor timing and positioning scenarios
- The green area (test building, Lat: 37.087698, Lon: -76.378767) used for fixed and underground/degraded timing scenarios



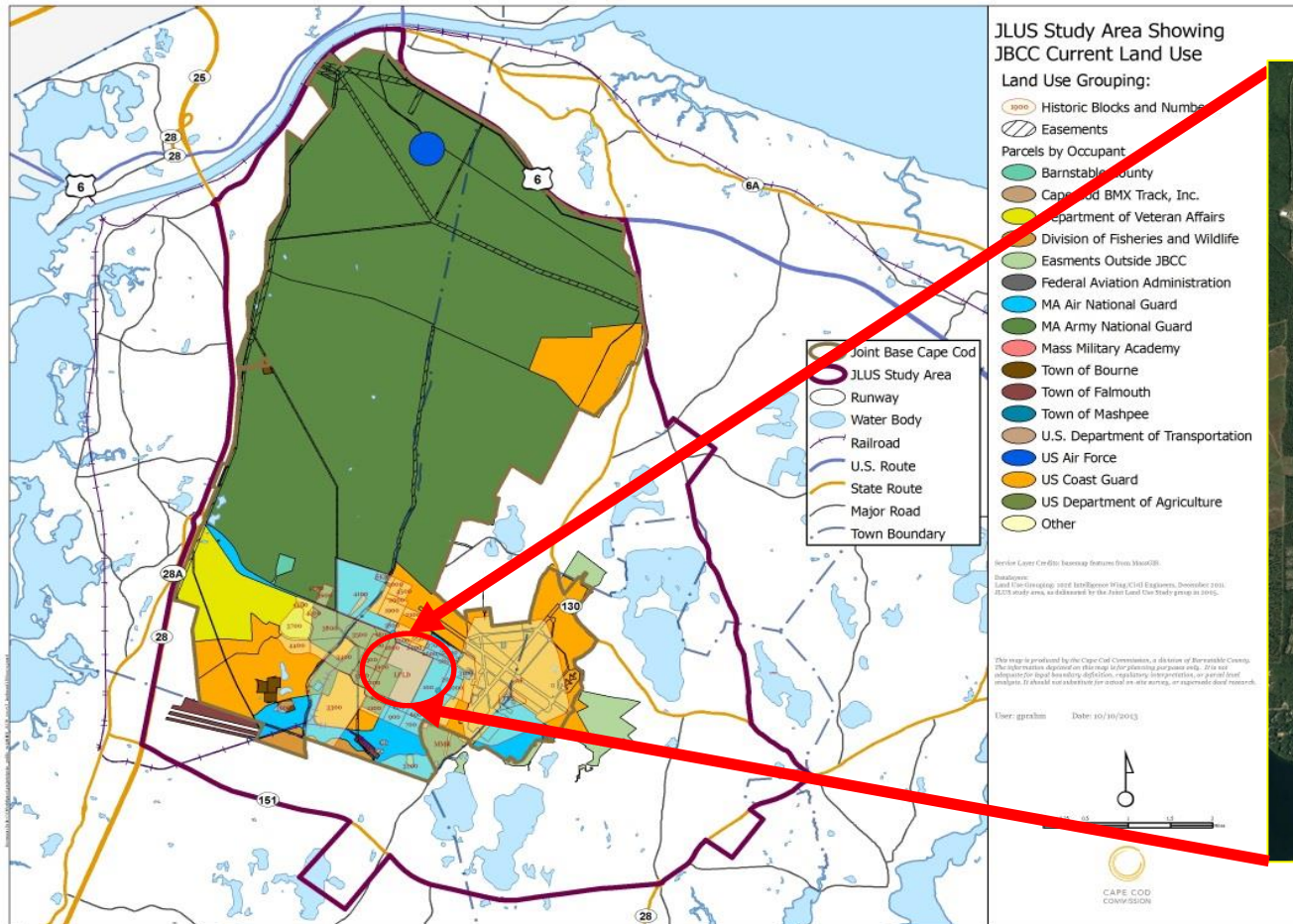
# 2D & 3D Platform & Reference System

## NASA Langley Research Center

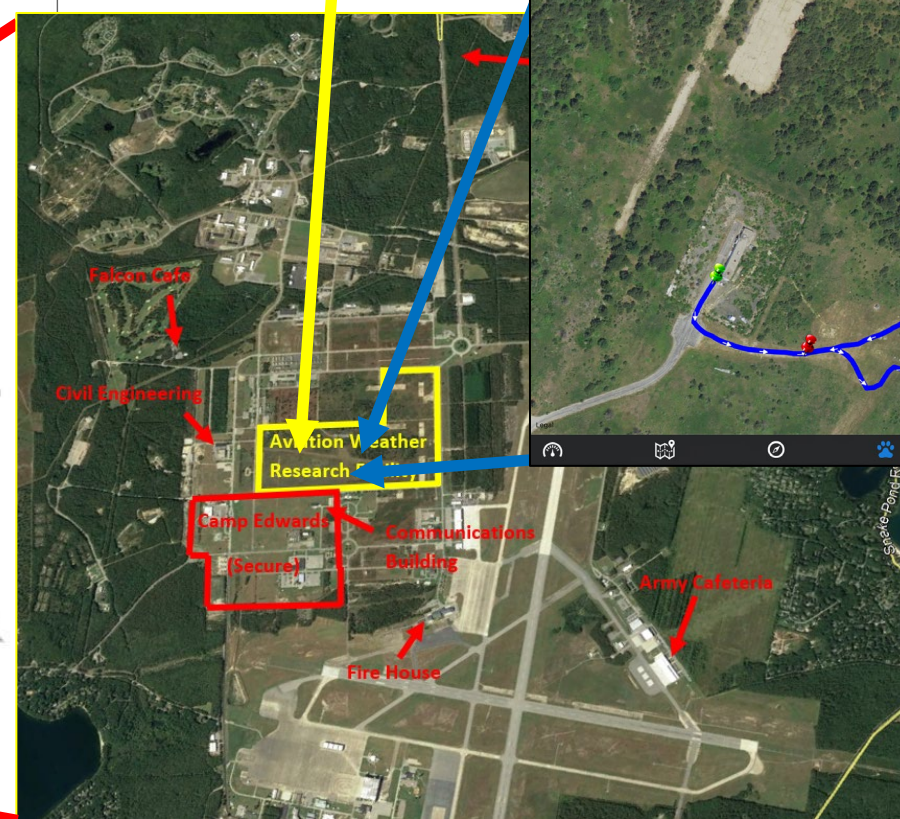




# Joint Base Cape Cod (JBCC) DOT/Volpe Field Facility



150 Acres  
Volpe Test Facility





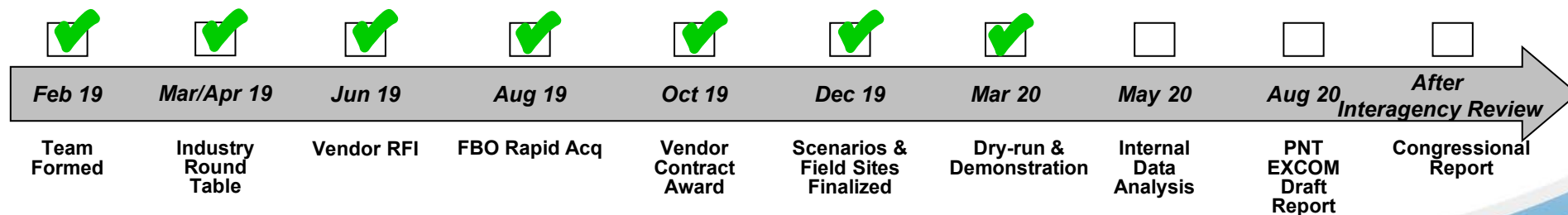
# 2D & 3D Platform & Reference System (JBCC)





# NDAA GPS Backup/Complementary PNT Demonstration Work Plan

- Executed two acquisitions, three field campaigns, technology demonstrations, and preparing PNT performance analysis report
- Awarded *11* PNT vendor demonstration contracts on rapid acquisition purchase orders
- Demonstration output products:
  - Performance report with PNT roadmap and measures of effectiveness for DOT leadership
  - Draft PNT strategy guide and cross-departmental coordination for PNT EXCOM



# Executive Order 13905: Strengthening National Resilience Through Responsible Use of PNT Services - February 12, 2020

- **Purpose:** Foster responsible use of PNT services by critical infrastructure owners and operators to strengthen national resilience
- **Policy:** Ensure disruption or manipulation of PNT services does not undermine reliability or efficiency of critical infrastructure
  - Raise awareness of the extent to which critical infrastructure depends on PNT services
  - Ensure critical infrastructure can withstand disruption or manipulation of PNT services
  - Engage public and private sectors to promote responsible use of PNT services

## **Implementation: Nine point implementation framework**

- DOC and Sector Specific Agencies (SSAs) to develop PNT Profiles—responsible usage aligned with standards, guidelines and requirements
- DoD/DHS/DOT to update Federal Radionavigation Plan with PNT Profiles
- DHS and SSAs to develop test plan against PNT service vulnerabilities and inform PNT Profile update
- DHS to coordinate with departments and agencies on contractual language for federal contracts that integrate or utilize PNT services
- Federal Acquisition Regulatory Council to incorporate PNT Profile contract language in FAR codes
- SSAs to update PNT Profiles biennially through DHS and report to White House Office of Science and Technology Policy (OSTP)
- DOT/DOE/DHS to engage with critical infrastructure owners and operators to evaluate responsible use of PNT services
- OSTP to develop national R&D plan for PNT services that are not dependent on GNSS and update quadrennially
- DOC to provide a GNSS independent source of UTC accessible to public and private sector



# EO 13905 Timelines

## Timelines and Coordination

- DOC Provision for Accessible UTC—180 days
- DHS/DOT/DOE Plan for Critical Infrastructure Engagement and Pilot Programs —180 days
- FAR Contractual Language Update with PNT Profiles—180 days
- OSTP R&D Plan for GNSS Independent PNT Service—1 year
- DOC/SSAs PNT Profiles—1 year, then biennial update
- DHS/SSAs PNT Service Test Plan on Vulnerabilities—1 year
- DHS/SSAs Report to OSTP on PNT Profile Adoption—1 year
- DoD/DHS/DOT Incorporation PNT Profiles to FRP--biennial

Questions?