

DOT PNT Update

Civil GPS Service Interface Committee

September 22, 2020



2019 Federal Radionavigation Plan




- GPS Adjacent Band Compatibility Results
- Termination of Nationwide Differential GPS (NDGPS)
- PNT Resiliency
 - Mitigation of Disruptions to GPS
 - Backup/Complementary PNT (NDAA Language)
 - Interference Detection
 - DHS Best Practices
- <https://www.navcen.uscg.gov/pdf/FederalRadioNavigationPlan2019.pdf>



Effect On GPS of One Ligado Base Station (1 dB) Based on DOT ABC Testing

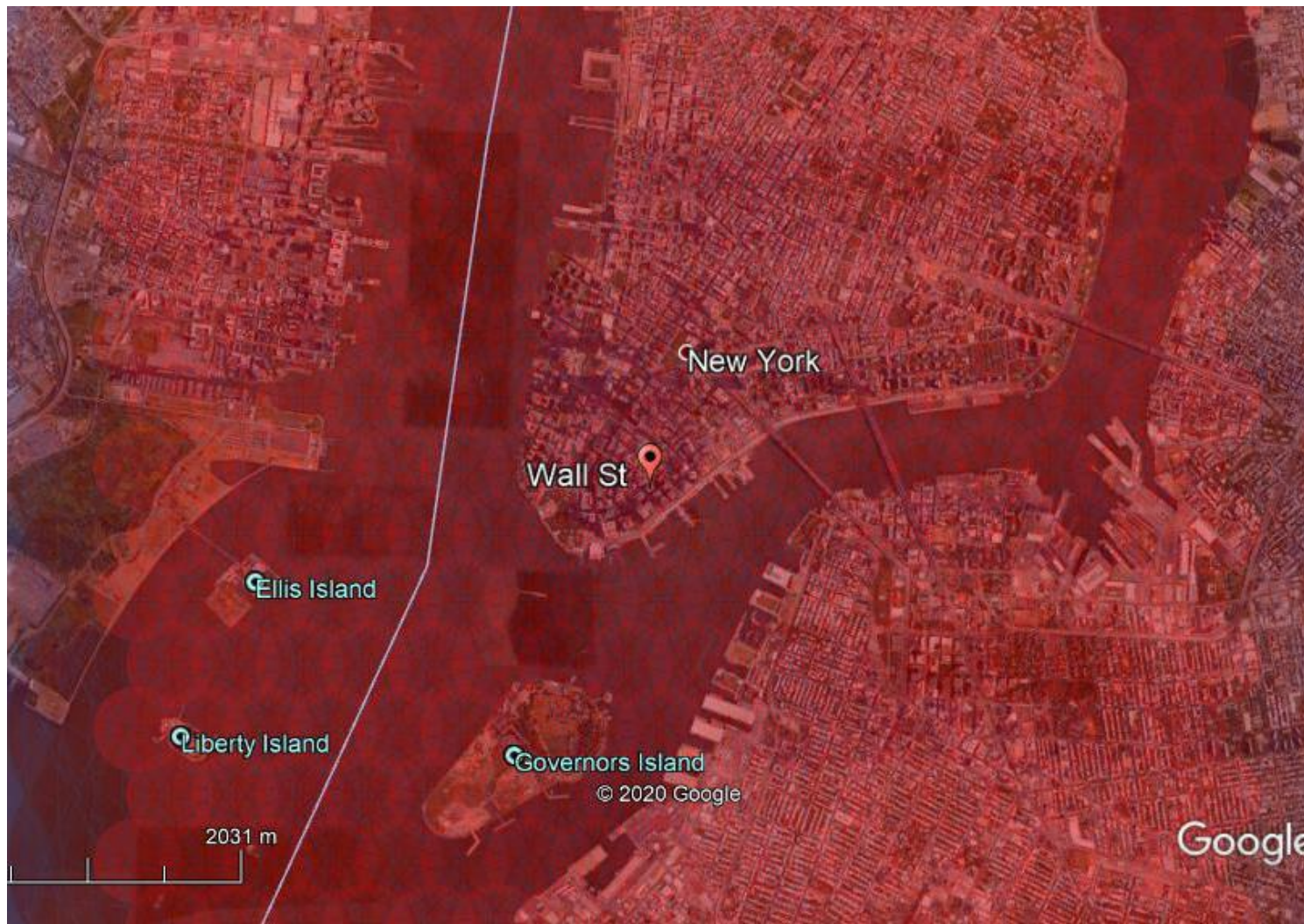


- 9.8 dBW base station placed in Lower Manhattan

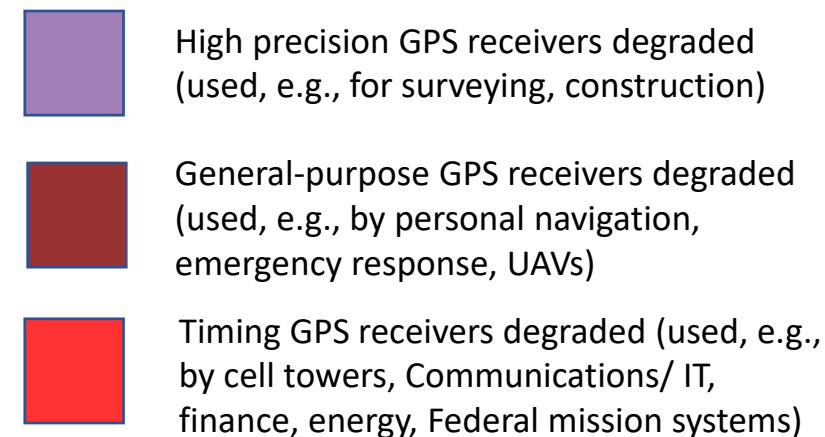
-  High precision GPS receivers degraded (used, e.g., for surveying, construction)
-  General-purpose GPS receivers degraded (used, e.g., by personal navigation, emergency response, UAVs)
-  Timing GPS receivers degraded (used, e.g., by cell towers, Communications/ IT, finance, energy, Federal mission systems)

* For illustration only.

Effect On GPS of Many Ligado Base Stations (1 dB) Based on DOT ABC Testing



- 9.8 dBW base station separated by 433 m in hexagonal grid*
- Blanketed Impact for All Receiver Categories



* For illustration only.

GPS Adjacent Band Compatibility Assessment: Maximum Tolerable Power Level for GPS/GNSS Receivers at 1530 MHz

Deployment	Stand off distance (m)	Max Tolerable EIRP (dBW)			
		GLN	HPR	TIM	CEL
Macro Urban	10	-31.0	-41.9	-20.6	10.9
	100	-11.0	-21.9	-0.6	31
Micro Urban	10	-29.8	-41.2	-20.1	10.7
	100	-9.8	-21.1	-0.1	30.8

Deployment	Stand off distance (m)	Max Tolerable EIRP			
		GLN	HPR	TIM	CEL
Macro Urban	10	0.8 mW	64 μ W	8.7 mW	12.3 W
	100	79.4 mW	6.5 mW	0.9 W	1.26 kW
Micro Urban	10	1 mW	76 μ W	9.8 mW	11.7 W
	100	104 mW	7.8 mW	1 W	1.2 kW

At proposed Ligado transmitter spacing, power must be reduced from 10 Watts to about one milliwatt (factor of 10,000) to protect all existing receivers

Summary of DOT GPS Adjacent Band Concerns

- ❖ The DOT GPS Adjacent Band Compatibility (ABC) test results clearly demonstrate there will be widespread disruption to GPS receivers.
- ❖ DOT serves as the Civil Lead for GPS and is concerned about the millions of receivers that will experience interference
 - The majority of civil GPS receivers are not U.S. Government devices and will not qualify for repair or replacement paid for by Ligado.
- ❖ FCC should thoroughly assess and account for the economic costs and burdens that will result.
 - Many GPS/GNSS receivers are hermetically sealed so it is not possible to retrofit them with new antennas.
 - Furthermore, many receivers are integrated into end-user applications making adversely affected GPS users unable to retrofit or replace their GPS receivers.

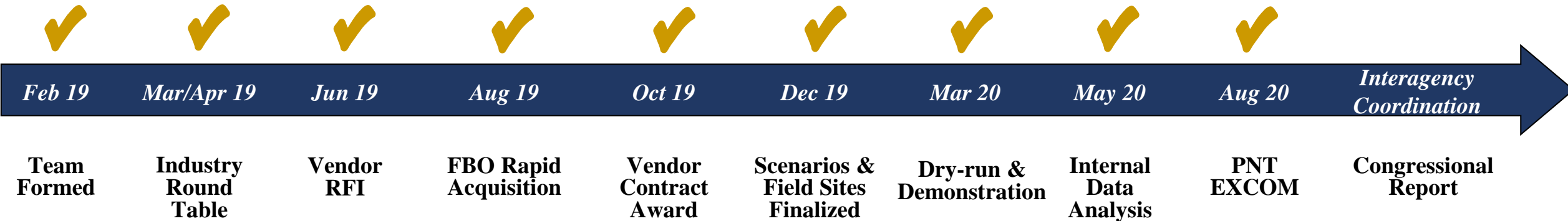


DOT PNT Research for Highly Automated Systems

- **PNT for Automated Vehicles (AV): ITS Joint Program Office**
 1. AV use cases / scenarios
 2. Determine PNT requirements for AV operations
 3. Assess GNSS and other candidate sensor technologies
 4. Analyze PNT performance of individual sensors
 5. Determine navigation performance enhancements achieved by sensor fusion
- **DOT University Transportation Center: Highly Automated Transportation System Research**
 - Awarded to consortium led by The Ohio State University (with UC Irvine, UT Austin, and University of Cincinnati): **Center for Automated Vehicles Research with Multimodal AssurEd Navigation (CARMEN)**
 - Assess PNT threat scenarios and risks to highly automated transportation systems
 - Standards, Guidelines, and Best-practices for cyber-resilient PNT systems
- **OST-R Highly Automated System Safety Center of Excellence**



FY18 NDAA GPS Backup Demonstration Status



- Awarded 11 PNT vendor demonstration contracts on rapid acquisition purchase orders
- Executed two acquisitions, three field campaigns, technology demonstrations, and preparing PNT performance analysis report