



January 5, 2024

National Space-Based Positioning, Navigation, and Timing (PNT) Executive Steering Group (ESG) Responses to PNT Advisory Board Recommendations

1. **PNT27-01-CER:** EXCOM is urged to develop a compelling, quantitative way to accurately express the economic damages to the nation attributable to extended disruptions to GPS services.

ESG Response: The ESG will discuss whether to begin a potential follow-on study to the 2019 Department of Commerce (NIST) study, “Economic Benefits of the Global Positioning System (GPS)” [link: https://www.nist.gov/system/files/documents/2020/02/06/gps_finalreport618.pdf], from June 2019, which found \$1.4T in U.S. economic benefits from GPS. The study stated that a 30-day widespread outage could erode >\$1 billion in economic value per day. The study also highlighted the impact a GPS outage would have on Agriculture, stating that during planting season, economic damages in the agriculture sector could increase 30-day losses to \$15 billion due to lower yields. The ESG will also review recent studies by our foreign partners, which assessed economic losses to them from GPS/GNSS disruptions. If it is determined that another study is required, also under Commerce leadership, DOT has indicated specific interest in assessing the economic impact on transportation applications due to the disruption, denial, and manipulation of GPS. It would be helpful to clarify the definition of “extended disruptions” before conducting such a study. Additionally, we would expect all affected civil agencies to contribute impact assessments within their areas of responsibility.

2. **PNT27-02-CER:** The Department of Transportation is urged to issue public warnings to GPS users as soon as possible after the beginning of significant disruption events.

ESG Response: The ESG notes that warnings of GPS disruptions would align with tasking in Space Policy Directive 7 (SPD-7) for DOT. Part d section (viii) of Space Policy Directive 7 states, “In coordination with the Secretary of Defense, the Secretary of Homeland Security, and the heads of other agencies, as appropriate, implement Federal and facilitate State, local and commercial capabilities to monitor, identify, locate, and attribute space-based PNT service disruption and manipulations within the United States that adversely affect use of space-based PNT for transportation safety, homeland security, civil, commercial, and scientific purposes;”

DOT and DHS can cooperate to assess the range of public warnings currently in use and determine whether different or additional methods will benefit civil users of GPS. At present, DOT is working with DOD and DHS to implement the use of the Naval Research Lab (NRL) GPS Operational Awareness Tool (GOAT) to provide a graphical “heat map” that could be used by civil agencies to notify the public when GPS interference is occurring.

- 3. PNT27-08-PTA:** The U.S. Government (USG) should rapidly prototype a National GNSS Interference Detection and Reporting system based on mobile wireless technology.

ESG Response: The ESG recognizes that detection of GPS disruptions is a direct tasking in Space Policy Directive 7 (SPD-7) for DOT “In coordination with the Secretary of Defense and the Secretary of Homeland Security and the heads of other agencies, as appropriate, implement Federal and facilitate State, local and commercial capabilities to monitor, identify, locate, and attribute space-based PNT service disruption and manipulations within the United States that adversely affect use of space-based PNT for transportation safety, homeland security, civil, commercial, and scientific purposes”

DOT is working with DOD and DHS and coordinating with other civil agencies with expertise in commercial mobile wireless technology to implement an automated GPS interference detection capability to leverage space, airborne, terrestrial, and cyber domain capabilities and achieve a multi-layer GPS interference detection and monitoring (IDM) capability. This GPS IDM enterprise capability will bring together information from several current and future performance monitoring technology resources. DOT has the resources to advance such an automated GPS IDM capability to an initial operating capability. Further resources are needed to operationalize and maintain that capability fully.

- 4. PNT27-03-CER:** PNT security should be made a prominent part of the National Cyber Director’s responsibilities. Departments and agencies should include PNT security in their cyber portfolios.

ESG Response: SPD-7 and EO 13905 highlight that GPS is a crucial component of multiple sectors of the United States critical infrastructure and recognize that national and economic security depends on reliable and efficient functioning. Since 2017, multiple EXCOM Departments and Agencies have included PNT security in their cyber portfolios, and the NCO, on behalf of the EXCOM, has advocated at numerous public events for Government and Private-Sector CIOs to include PNT security in the cybersecurity plans. The ESG will discuss whether to make a recommendation to the Executive Office of the President (EOP) to change the responsibilities of the Office of the National Cyber Director (ONCD). It would be beneficial to bring ONCD into the EXCOM/ESG process to focus on PNT.

- 5. PNT27-04-ECAS:** USG to develop and implement a GPS High Accuracy and Robustness Service (HARS) delivered to users via the Internet, with performance initially comparable to that provided by other GNSS such as the European Union’s Galileo High Accuracy Service (Galileo HAS).

ESG Response: Part d section (xiii) of Space Policy Directive 7 states, "In coordination with the Secretary of Defense and the Secretary of Homeland Security, develop and validate requirements and a funding strategy to implement data and signal authentication of civil GPS and wide area augmentations for homeland security and public safety purposes consistent with the Federal Radionavigation Plan or its

successor plan." This effort already aligns with the work DOT has underway for out-of-band authentication. The FAA provides WAAS and could disseminate WAAS corrections over the internet like efforts that the Europeans are already doing with EGNOS.

Following the May 2023 PNTAB meeting, to satisfy an action taken during a subsequent meeting of the National PNT Engineering Forum (NPEF), leadership of the PNTAB, NASA, and USCG Navigation Center (NAVCEN) engaged to discuss whether existing capabilities at NAVCEN could host public distribution of corrections from NASA/JPL's Global Differential GPS System (GDGPS) via the internet. During this discussion, it was agreed to conduct a beta test followed by a briefing to the Civil GPS Program Management Review (PMR) in March 2024.

6. PNT27-05-ESI: USG to invest in the future of U.S. PNT education and training. There is a definitive shortage of geodesy experts being trained in relation to competitor nations such as China.

ESG Response: SPD-7 and EO 13905 highlight that GPS is a crucial component of multiple United States critical infrastructure sectors, stating that national and economic security depends on reliable and efficient functioning.

The ESG Departments and Agencies have PNT education and training efforts ongoing now. They will discuss other potential whole-of-government approaches to this shortage, including possible sponsorship of initiatives with nationwide educational institutions in coordination with other Science, Technology, Engineering, and Math (STEM) efforts across the U.S. Government. DOT has established two University Transportation Centers (UTCs) focused on Assured PNT: The Ohio State University and the Illinois Institute of Technology. Workforce development is a vital component of both of these UTCs. Each UTC is funded at \$2M/year for five years (starting in 2023).

In coordination with NASA and USGS, the National Geospatial-Intelligence Agency (NGA), and NOAA's National Geodetic Survey (NGS), they established a Geodesy Community of Practice in FY23. Research, workforce, and academic partnerships are part of the COP effort. Additionally, NGS issued \$4M in Geospatial Modeling Grants in FY23 to academic partners.

The NCO has worked with teachers across the U.S. for over five years promoting STEM in schools with free GPS-themed STEM educational products, such as the "How GPS Works" poster. NCO is developing a proposal for a phase 2 GPS-themed STEM curriculum that would align with upgrades to the GPS.gov website.

The U.S. has supported workshops through ICG funding provided to the U.N. Office for Outer Space Affairs and through participation in some of the workshops/meetings:

- United Nations/Finland Workshop on the Applications of Global Navigation Satellite Systems, 23 - 26 October 2023, Helsinki, Finland
- Eastern Africa Capacity Building Workshop on Space Weather and Low-latitude Ionosphere, 3 - 12 October 2023, Malindi, Kenya

- Technical Seminar on Reference Frames in Practice (FIG Working Week 2023), 27 - 28 May 2023, Orlando, Florida
- Training program on Global Navigation Satellite Systems (GNSS), 3 - 6 January 2023, Pokhara, Nepal
- United Nations International Meeting on the Applications of Global Navigation Satellite Systems, Vienna, Austria, 5 - 9 December 2022
- United Nations/Mongolia Workshop on the Applications of Global Navigation Satellite Systems, Ulaanbaatar, Mongolia, 25 - 29 October 2021

7. **PNT27-06-PTA:** There currently are wildly diverse opinions concerning the likelihood and extent that the GPS infrastructure could fail to provide useful signals in different time frames. Those making risk management decisions, and those investing in Protect, Toughen, and Augment, lack the information needed to select the appropriate approaches, and how urgent it is to implement them. Therefore, the USG should establish, publish, and maintain estimates of the likelihood that GPS would not provide sufficient useful civil signals, due to failures of the GPS infrastructure (GPS Ground Segment, GPS Space Segment, and GPS user equipment) from any cause.

ESG Response: SPD-7 and EO 13905 highlight that GPS is a crucial component of multiple sectors of the United States critical infrastructure, stating that national and economic security depends on the reliable and efficient functioning. The ESG notes that conducting risk assessments to support risk management is essential. However, determining the likelihood that GPS infrastructure (GPS Ground Segment, GPS Space Segment, and GPS user equipment) could fail for any reason is very challenging. The possibility of threats could change more quickly than the ability to react to them. DOT supports risk assessments by applying the NIST PNT profile in support of the implementation of EO 13905 and released a DOT Complementary PNT Action Plan in September 2023. DoD and ODNI-related risk assessments are also routinely conducted across the Intelligence Community and reported to the ESG and EXCOM.

To address GPS vulnerabilities in critical infrastructure, the DHS Science and Technology Directorate (S&T) PNT program has a multi-pronged approach of conducting vulnerability and impact assessments, developing mitigations, exploring complementary timing technologies, and engaging with industry through outreach events and meetings. Through these sustained efforts, the program's goal is to increase the resiliency of critical infrastructure to GPS vulnerabilities in the future.

8. **PNT27-09-SPG:** Convene a White House summit to recognize and celebrate U.S. achievements with GPS and to launch an initiative to regain U.S. PNT leadership and ensure resilient, reliable PNT for critical infrastructure and the larger economy. GPS's capabilities are now substantially inferior to those of China's BeiDou.

ESG Response: This year marks the 50th anniversary of the Global Positioning System program. In December 1973, the Defense Systems Acquisition Review Council (DSARC) approved the U.S. Air Force to develop the Navstar Global Positioning System (GPS). GPS has provided America and the world with innumerable and valuable benefits. It has also symbolized America's strength and global leadership for decades. Recommitting U.S. positioning, navigation, and timing (PNT) leadership must be a key public policy objective in an era of great power competition. The EXCOM/ESG has worked to promote the 50th Anniversary of GPS through speeches, presentations, interviews, and events.

- On August 24, 2023, the Director of the National Coordination Office for Space-Based PNT was interviewed by Bloomberg News for a piece on GPS. The article "MapLab: The Secret History of GPS" was published on September 27, 2023. The piece highlighted the GPS 50th anniversary, several significant GPS achievements, and the U.S. commitment to continued leadership in PNT.
- At the Civil GPS Service Interface Committee (CGSIC) meeting held in September 2023, the original GPS Program Manager presented the "History of the GPS Revolution on the Occasion of the 50th Anniversary of Gaining Initial Approval in December 1973." The conference was covered in GPS World and Inside GNSS publications.
- On November 14, 2023, the GPS Innovation Alliance (GPSIA) hosted an event on Capitol Hill attended by government and industry leaders to celebrate the achievements of the first 50 years of the Global Positioning System (GPS) and look to continued U.S. leadership in GPS. Speakers included two Senators who are co-chairs of the GPS Caucus, the Department of Transportation Deputy Assistant Secretary for Research and Technology, and a Brigadier General from the U.S. Space Force who is the Director of Plans and Programs.

9. PNT27-10-SPG: The Executive Office of the President should undertake an Administration-wide review of domestic radio spectrum regulation processes.

ESG Response: In compliance with SPD-7 and EO 13905, the EXCOM Departments and Agencies have been involved with developing the Presidential Memorandum entitled *Modernizing U.S. Spectrum Policy and Establishing a National Spectrum Strategy*. The White House released the memorandum on November 13, 2023. This is a common recommendation from the A.B., GAO, and the National Academies as reflected in the NASEM assessment of spectrum related to Ligado and GPS. NTIA released a National Spectrum Strategy (NSS) on November 13, 2023.

10. White Paper Topic: Modifying U.S. International Traffic in Arms Regulations (ITAR) on GPS Commercial Users: To toughen GPS and enhance user access and reliability, the USG must modify export control regulations that restrict commercial use of adaptive antijam antenna systems protecting GNSS receivers. The original intent to mitigate the proliferation of this technology has been superseded by U.S. competitors' development and fielding of this technology.

ESG Response: The State Department, as the owner of the International Traffic in Arms Regulations (ITAR) process, has been working with the interagency on a Targeted Revisions Notice of Proposed Rulemaking for Categories XI(c)(10) and XII(d)(3) on the U.S. Munitions List 9(USML). State-PM/DTCP is currently drafting the Notice and will take into consideration input collected through the interagency coordination process. State is also coordinating closely with the Department of Commerce on the final Notice since DOC controls the Export Administration Regulations (EAR), which goes hand-in-hand with the ITAR process.

This item was not included in the original PNTAB recommendations sent to the EXCOM Departments for review and is being included now for the first time.

Note: PNTAB Recommendations are from the Nov 2022 PNTAB meeting, sent via PNTAB Chairman letter to the National Space-Based PNT Executive Committee (EXCOM) in January 2023. The EXCOM directed the ESG to develop responses on their behalf and send them to the PNTAB.

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