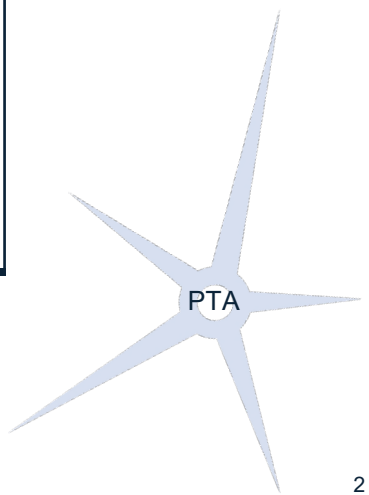
SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL ADVISORY BOARD

PTA Subcommittee Update

PTA Subcommittee
4 December 2024

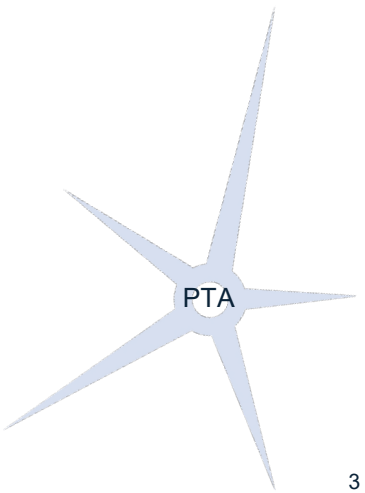
PTA Subcommittee Members and Charter

Members:	Role/ Study Areas:
• John Betz, Chair • Tim Murphy, 1st Vice-Chair • Tom Powell, 2nd Vice-Chair • Scott Burgett • Bryan Chan • Pat Diamond • Renato Filjar • Michael Hamel • Larry James • Vahid Madani • Logan Scott • Todd Walter	• Protect: Measures that prevent or remove conditions that degrade, distort, or deny GPS use • Toughen: Measures that make GPS use more robust against challenges and threats • Augment: Provision of GPS enhancements as well as provision and use of alternate PNT sources that complement, back up, or replace use of GPS



Identifying Ways to Protect, Toughen, Augment Use of GPS

- Consider national policies, executive orders, other directives concerning PNT
- Emphasize pragmatic near-term approaches to enhance PNT for critical infrastructure
- Benefit from PNT capabilities of allies
- Learn from what other nations are doing and how they are doing it



Recent Documents Provide Ample Guidance and Directives

- Executive Order 13905, Strengthening National Resilience Through Responsible Use of Positioning, Navigation, and Timing Services (February 2020)
  - 9 implementation directives
- Space Policy Directive 7, The United States Space-Based Positioning, Navigation, and Timing Policy (January 2021)
  - 11 broad items of policy goals and guidance
- National Security Memorandum on Critical Infrastructure Security and Resilience (April 2024)
  - 8 policy principles and objectives
  - 8 objectives of the United States
  - Roles and responsibilities for Secretary of Homeland Security, Federal Senior Leadership Council, Department of State, Department of Defense, Department of Justice, Department of Commerce, Department of Energy, Intelligence Community, Director of the National Security Agency, General Services Administration, Nuclear Regulatory Commission, Federal Communications Commission, Interagency Bodies

What Has Changed in Fielded Capabilities to Protect, Toughen, Augment?

Summary of “PTA Day,” 24 April 2024

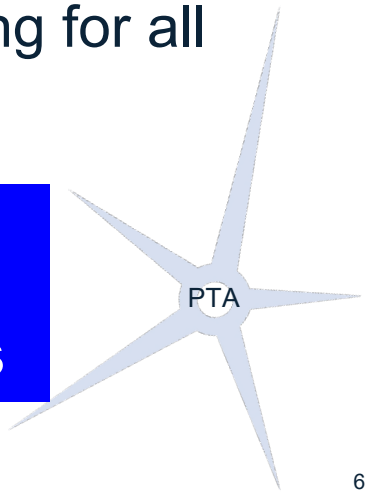
- Pragmatic near-term approaches to enhance PNT for critical infrastructure
- National capability for interference monitoring and removal is needed; current development effort lacks operational concept, requirements, resources and program of record to meet the threat
- There are many ways to make GPS/GNSS use tougher and more competent—mostly through user equipment design and integration
  - Currently limited by obstacles and lack of information
- Pragmatic steps can be taken to augment GPS use for critical infrastructure
  - Near-term options are limited but some good ones exist
  - There is an opportunity to better focus resources for longer term developments
- There is no known activity across Federal Sector Specific Agencies to measure PNT service toughening and augmentation in critical infrastructure

PNTAB Recommendations Relevant to “PTA Day”

- Commitment to prompt detection and removal of significant interference to GPS reception
- Designate single lead agency/official responsible for end-to-end prompt detection, characterization, and removal of significant PNT interference sources in U.S.
- Modify export controls currently limiting civil use of antijam antenna systems
- Promptly implement essential monitoring and controls to enable operational use of the GPS L5 signal
- Federal agencies should adopt and advocate widespread use of multifrequency GPS/Galileo receivers
- Promptly develop/implement GPS High Accuracy and Robustness Service for civil users
- Inform users of the likelihood of GPS failure to provide useful signals, accounting for all causes

All Are Consistent with Current Governance Structure

Prompt Implementation Could Massively Improve Civil PNT Services



Providing the PNTAB's Comparison of Civil PNT Service Capabilities in U.S. and China

- Objective: collaboratively develop comparison that is unambiguous, consistent, complete, informative
- Caveats:
  - Addresses provision of service, not user adoption of services
  - Costs unavailable in most cases, not considered in assessment
  - Capabilities (e.g., accuracy, integrity, continuity, time to fix) to meet specific critical infrastructure use case needs not included in assessment
  - Vulnerabilities to various potential attacks not considered
  - Some information about China's capabilities is unknown, including which firms in China are state-owned enterprises and which are privately-owned
- Evaluation criteria:
  - Blue = Current operational capability with extended features over needed service region
  - Green = Current basic operational capability over needed service region
  - Yellow = Capability for needed service region under development
  - Red = No current capability, none under development

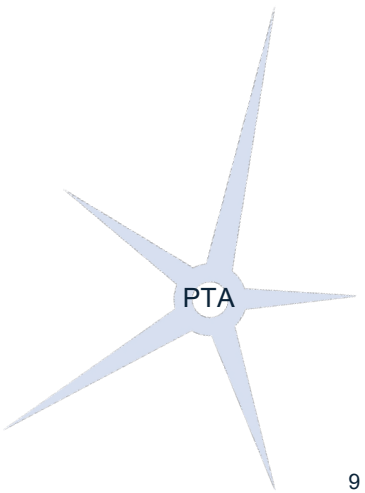
Comparison of PNT Services Available to Civil Users						
System or Capability	United States				China	
	Timing		Positioning		Timing	Positioning
	Government-Provided	Commercial-Provided	Government-Provided	Commercial-Provided		
Global Navigation Satellite System	GPS [1], **Galileo**	[1]	GPS [1], **Galileo**	[1]	BeiDou, Galileo(?)	BeiDou, Galileo (?)
LEO Satellites		Iridium STL [2]		TrustPoint, Xona, NAL, Parsons	[3]	[3]
Terrestrial Broadcast	WWV, WWVB	ATSC 3.0 BPS [4], [8]		ATSC 3.0 BPS, mobile phones [4], [8]	eLoran Infrastructure Installed [5]	Mobile phones
Fiber-Based Timing		Major Telecoms, [8]	Not Applicable	Not Applicable	Comprehensive Government Program Being Implemented [6]	Not Applicable
Authentication/ Integration of Timing		Unknown What Iridium STL and Major Telecoms Offer and Plan	Not Applicable	Not Applicable	Comprehensive Architecture Being Developed [7]	Not Applicable

Notes and references in Notes page and final slide

Observations from U.S.-China Comparison

- GPS is still a leader in reliability, transparency, adoption
- BeiDou has more integrated operational features than GPS, due in part to delays in GPS Modernization
- U.S. civil use of Galileo can provide great advantages
- U.S. civil capabilities are diversified across Government and commercial

There are advantages and disadvantages to each observation



Thoughts on Way Ahead

- PTA Subcommittee seeks closer collaboration with Communications and External Relations Subcommittee to publicize:
  - Outcomes of “PTA Day” and associated PNTAB recommendations
  - Enhanced comparison of U.S.-China PNT services
- PTA-focused paper for presidential transition team
  - Issue: There are widespread concerns that U.S. Government has not taken the urgent and practical steps needed to Protect, Toughen, and Augment the use of GPS for positioning, navigation, and timing. The resulting unprotected reliance on currently fragile GPS makes the U.S. economy, critical infrastructure, and national defense unnecessarily vulnerable to accidental, natural, and malicious events.
- Suggestion for next PNTAB meeting:
  - Review recent national PNT-related orders, directives, memoranda
  - Summarize actions and responsible parties
  - Assess progress in fielding capabilities to implement them, recommending improvements as appropriate

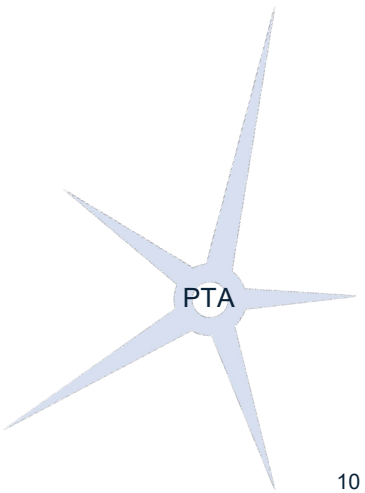


Table Notes and References

1. Meets all performance standards. Some functions provided by third parties (e.g., SBAS, precision corrections).
2. STL Satellite Time and Location - Alternative to GPS (satelles.com)
3. Numerous announcements, papers. See for example presentation at UNOOSA
4. ATSC 3.0 BPS provides timing across much of the U.S. and can provide positioning, current plan is free public service. Reference correspondence with Pat Diamond, PNTAB, and Sam Matheny, National Association of Broadcasters. Also, current and planned cellular services provide positioning 5G positioning: What you need to know - Ericsson
5. China completes national eLoran network
6. Numerous Chinese academic papers, several media announcements see for example: "The Paper – Accelerate construction, High-precision, Ground-based Timing System"
7. National Time Service Center, Chinese Academy of Sciences
8. Department of Transportation Awards $7 million for Complementary Positioning, Navigation and Timing Technologies | US Department of Transportation