



SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL ADVISORY BOARD

GDGPS Way Ahead

GDGPS Task Force
9 December 2021

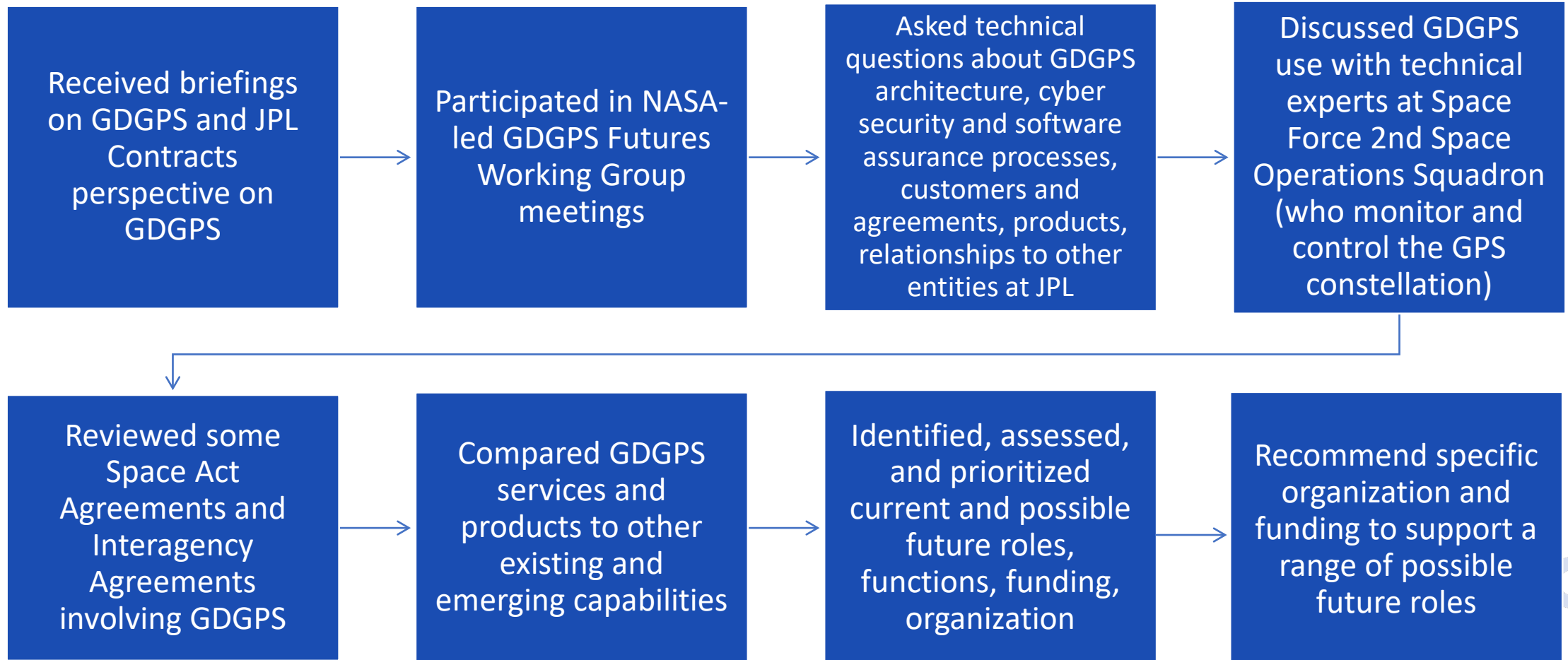


Introduction

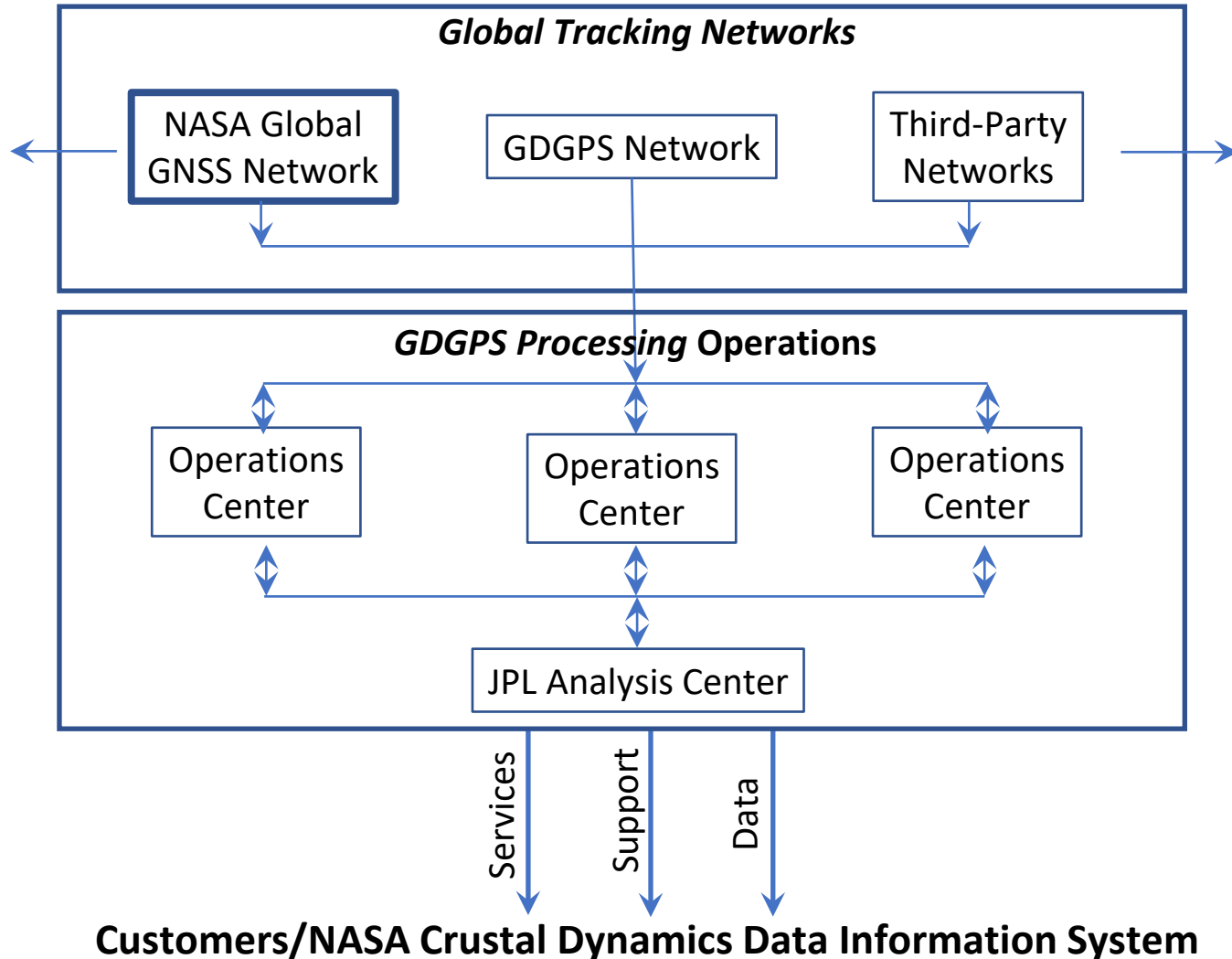
- **JPL's Global Differential GPS (GDGPS) system has been a National Treasure**
 - Providing critical real-time GNSS information to NASA, the Air Force and Space Force, and other customers for more than two decades
- **NASA and JPL have requested advice from the National Space-Based Positioning, Navigation, and Timing Advisory Board (PNTAB) concerning the future of GDGPS**
 - Including functions, funding mechanisms, organization, and management
- **PNTAB established a GDGPS Way Ahead Task Force**
- **These slides provide the consensus views of this Task Force – findings and recommendations**



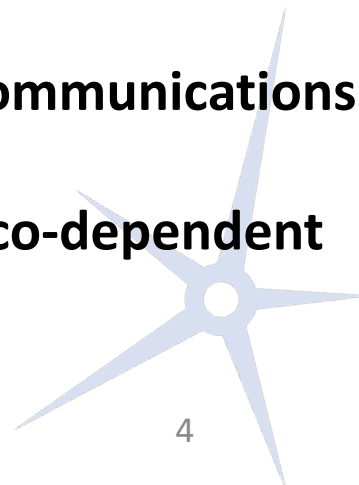
Task Force Process



GDGPS Description



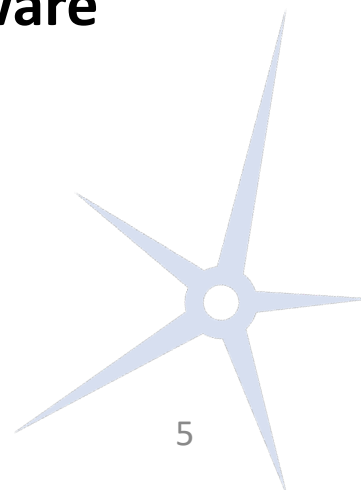
- **Hundreds of GNSS receivers worldwide**
- **Feeding JPL-developed software**
- **Running on commercial hardware at multiple sites**
- **Providing products and services to customers**
- **Via various networks and communications links**
- **NASA GGN and GDGPS are co-dependent**



GDGPS Outputs and Services*

- Data management for high performance GNSS tracking networks
- Support to NASA Space Geodesy Program and Global GNSS Network
- Precise “real-time” positioning and orbit determination for NASA and Air/Space Force
- GPS performance monitoring, calibration, and situational assessment supporting GPS operations
- Real-time differential corrections for GNSS
- “Real-time” environmental monitoring
- Assisted GNSS data
- GDGPS-developed/derived software

All Paid for by GDGPS Customers Except Raw GPS Measurements



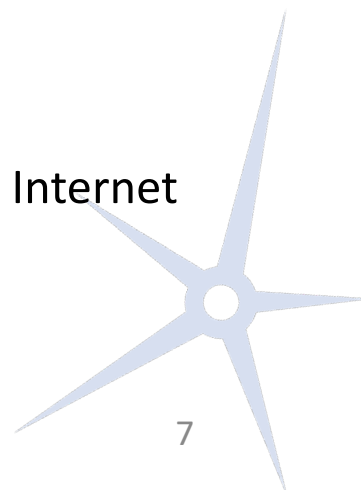
Key Findings

- **GDGPS has been a pioneer in many ways; it remains a national treasure**
- **GDGPS's operation as a JPL Service Center has enabled it to provide wide-ranging benefits to NASA programs at little direct cost to NASA**
- **Funding sources and funding limitations influence and constrain GDGPS products, services, behavior**
- **Changes are happening to current products, funding approach, other factors**
- **GDGPS remains the only non-commercial, U.S.-based, Federally-controlled entity at the state of the art for precise global GNSS "real-time" positioning and orbit determination**



Recommended Way Ahead (1 of 2)

- **GDGPS remains important to the Nation, U.S. Government, and NASA; it should remain at JPL with an evolved role and NASA funding**
- **PNTAB recommends GDGPS continue as a JPL project under NASA funding**
 - JPL phase out GDGPS service to most commercial entities except Government contractors
 - NASA establish funding line to cover infrastructure, sustainment, upgrades, some additional activities, products to NASA, and some R&D
 - Establish framework for sharing GDGPS software and products, allowing wide use
 - Increase transparency about GDGPS funding and expenditures
 - Maintain entrepreneurial aspect
 - Maintain existing support with Air Force/Space Force, using AF/SF funding
 - Pursue Space Force interest in providing high accuracy GPS corrections and E911 data via Internet to enhance GPS services
 - Pursue other funding sources for selected other potential future roles
- **Need further estimates of costs, including transition costs, for the different options**



Recommended Way Ahead (2 of 2)

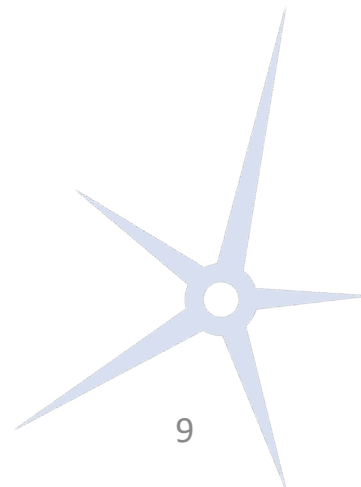
Consider the following steps:

1. **Develop and maintain solid documentation of GDGPS:** architecture, facilities, functions, products
2. **Undertake thorough security review of GDGPS:** security strategy and plan, risks and mitigations, formal assessments using (for example) NIST Cybersecurity Framework and DoD Cybersecurity Maturity Model Certification (CMMC), threat modeling, red teaming
 - A. Assess security risk from supporting of NASA and Air Force/Space Force activities
 - B. Assess security risk of providing data for operational and critical applications
 - C. Establish and maintain appropriate security posture

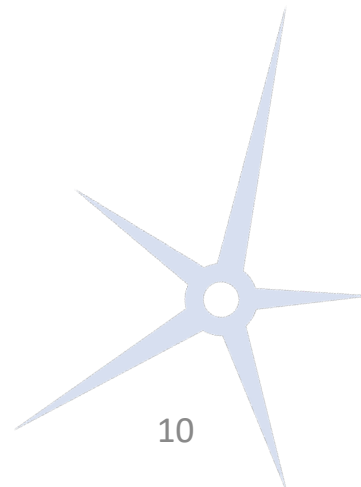
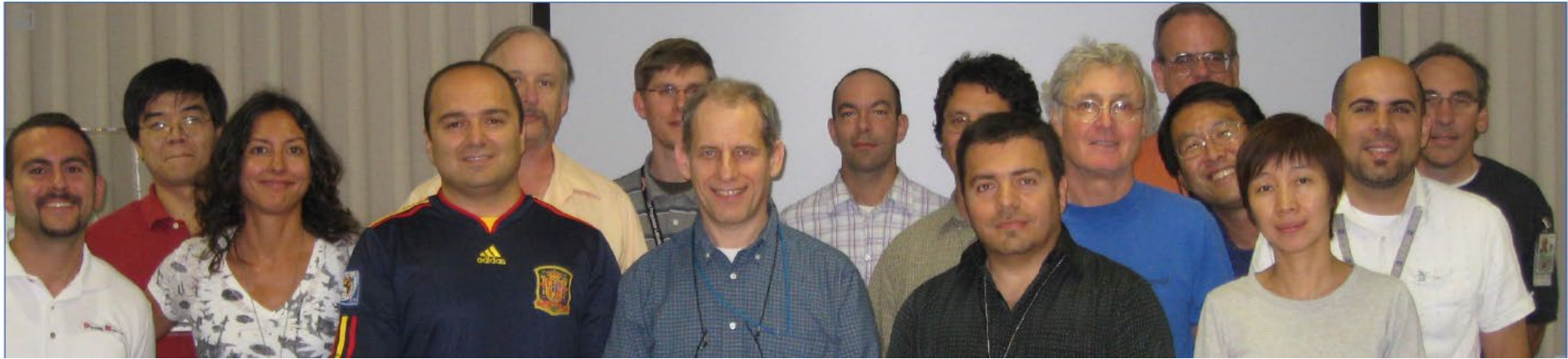


Two Important Cautions for Implementation

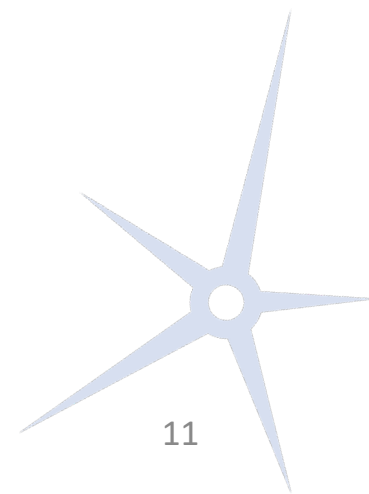
- 1. Properly managing the transition is essential**
 - Careful handover from commercial activities to NASA funding
- 2. Assured long-term stability of NASA funding is essential**



GDGPS Is an Impressive Capability



Backup Slides

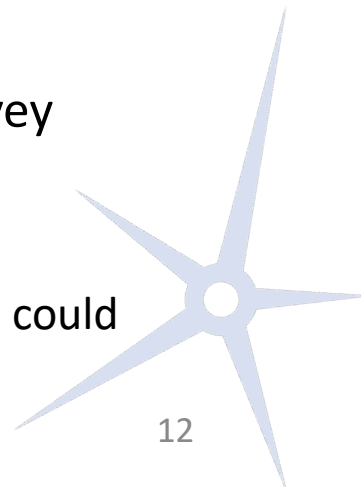


Task Force Members and Affiliations

- John Betz, Chair: PNTAB Member, The MITRE Corporation
- Todd Walter, Vice Chair: PNTAB Member, Stanford University
- Thad Allen: PNTAB Chair
- Penny Axelrad*: PNTAB Member, University of Colorado Boulder
- Matt Higgins: Representative, International GNSS Society (Australia)
- John LaBrecque: Consultant to the Task Force, University of Texas Center for Space Research
- Terry Moore: Representative, University of Nottingham (UK)
- Tim Murphy: PNTAB Member, The Boeing Company
- Brad Parkinson: PNTAB First Vice Chair, Stanford University
- Gary Thompson: PNTAB Member, North Carolina Emergency Management/Geodetic Survey
- Frank van Diggelen: PNTAB Member, Google

As Special Government Employees, only the PNTAB members are Special Government Employees and could access all the information provided by NASA and JPL

*Participated in fact finding; recused from recommendations



Terms of Reference: Way Ahead for the GDGPS System

28 August 2020

Background

The Global Differential GPS (GDGPS) System consists of a worldwide network of monitoring stations with software that processes their outputs, along with the outputs of other monitoring stations, to provide real-time and near-real time estimates of the orbital and clock states of GPS/GNSS constellations, the navigation messages, and environmental and geophysical parameters. Also provided are a variety of derived data products, such as orbit and clock predictions, orbit and clock corrections, situational assessment information, and natural hazard monitoring. GDGPS has been developed and operated by NASA's Jet Propulsion Laboratory (JPL) over the past 20 years, pioneering many aspects of this precise monitoring and corrections. GDGPS has been funded by NASA, the DoD, and other users of its products. Some real-time data from GDGPS monitoring station is shared publicly, its software has been licensed for various applications, and its products are provided to various U.S. Government and commercial entities for scientific, industrial, and operational purposes.

The GDGPS system is now at a crossroads. It continues to provide innovative developments and useful products, some that support operational services, and some that may be deemed essential. Yet as an FFRDC, JPL is a research organization and is not chartered to provide long term essential operational products for commercial use. Also, some other monitoring networks and systems, and commercial services (for Assisted GNSS, Precise Point Positioning, Real-Time Kinematics, etc.), provide products that have some similarity to those of GDGPS. In this situation, NASA and JPL are seeking guidance from the PNTAB concerning the way ahead for the GDGPS system.

Authority

Section 13 of the Charter of the National Space-Based Positioning, Navigation, and Timing (PNT) Advisory Board states, "As authorized by the NASA Designated Federal Officer (DFO), the PNT Advisory Board work may be organized and supported by committees, subcommittees, task forces, and expert consultants to ensure taskings are appropriately completed, in a timely manner, in consultation with the PNT Board Chair or Vice Chair. In addition, NASA may authorize consultants with special expertise to support such subordinate groups on an ad hoc basis. Such, subcommittees and/or task forces will be comprised of appointed PNT Advisory Board members and will report their findings and recommendations to the PNT Advisory Board Chair or Vice-Chair."

Tasking

The PNTAB will establish a task force that will perform fact finding involving three tasks:

1. Fact finding—establish and document the current situation: its functionality, budget, funding sources; the existing uses of and the reliance on its products (monitor station data, software, correction products); the ease by which other scientific missions can utilize its products and can request additional outputs; and its relationship to other apparently similar operations. Determine the extent it is currently a research effort versus an operational capability with attendant cybersecurity, software assurance processes, assured performance metrics, etc.
2. Identify options for the future of GDGPS, with pros and cons, describing functionality, organizational structure, customers, other government users, funding, and role in the GNSS community (including research vs. operational)
3. Recommend which option should be pursued, with rationale

The task force will consist of board members and consultants authorized by the DFO on an ad hoc basis. The meetings will be open to all PNTAB members except when discussing U.S.-only information, such as documentation labeled by NASA and/or JPL as proprietary or ITAR-restricted.

Product

The task force will provide a slide presentation capturing the results of the three tasks to the entire PNTAB. The PNTAB will then revise and modify as needed before voting on endorsing the presentation and recommendation.

If the task force deems that there is U.S.-only information that should also be briefed to the board, additional briefing slides will be prepared and made available only to U.S. persons.

Schedule

Fact finding results: 15 October 2020

Options: 15 November 2020

Recommendation for PNTAB deliberations: 1 December 2020

Final presentation: 31 December 2020