PNT Interference Detection

U.S. Organization and Operating Concepts
Civil Users Need A Means For:

Provider officials to disseminate system information (system status, health and modernization plans).

Worldwide user input/feedback (feedback on adequacy of signals for user needs, new applications).

Global industry participation.

Interference/outage reporting mechanism (process for interference detection and mitigation).

User advocacy (a means by which system users can be represented in all parts of the system planning and operation).
Assignment of Civil Interface Duties

• 1986 – When GPS became a dual-use (Military/Civil) system, DOD formed an MOU with DOT for GPS Civil Interface.

• DOT assigned operational interface to U.S. Coast Guard for dissemination of GPS operational information

• Civil GPS Service Interface Committee (CGSIC) was formed. This is now a DOT RITA responsibility as liaison between world’s civil GPS users and U.S. GPS authorities
Civil GPS Service Interface Committee was chartered to be that forum.

Recognized worldwide forum for effective interaction between all civil GPS users and the U.S. GPS authorities.

Established and chartered to identify civil GPS user needs (e.g. navigation, timing, and positioning).

Exchange information concerning GPS with the worldwide civil user community.

Reports activities to the Office of the Assistant Secretary for Transportation.
U.S. Space-Based PNT Organization Structure

WHITE HOUSE

NATIONAL EXECUTIVE COMMITTEE FOR SPACE-BASED PNT

Executive Steering Group
Co-Chairs: Defense, Transportation

NATIONAL COORDINATION OFFICE
Host: Commerce

ADVISORY BOARD
Sponsor: NASA

Defense
Transportation
State
Interior
Agriculture
Commerce
Homeland Security
Joint Chiefs of Staff
NASA

GPS International Working Group
Chair: State

Engineering Forum
Co-Chairs: Defense, Transportation

Ad Hoc Working Groups
CGSIC is the World-Wide Forum Between Civil GPS Users and U.S. Government Service Providers

Civil GPS Service Interface Committee (CGSIC)

Chair, DOT/RITA
Deputy Chair
CO, NAVCEN
Intl. Deputy Chair

Advisory Board
- Aviation
- Land
- Marine
- Subcommittee Chairs
- State

Subcommittees
- International
- Timing
- U.S. States
- Surveying, Mapping and Geo-Sciences

General Membership
Civil Liaison

DOT Research and Innovative Technologies Agency assigned responsibility as PNT Lead for Civil GPS

Civilian liaison positions were established throughout the GPS program to safeguard civil interests:

• GPS Directorate Liaison
• Civil liaison at U.S. Space Command
• U.S. Coast Guard Navigation Center Committee Co-Chair Executive Secretariat
  Coast Guard liaison at 2SOPS
NAVCEN Liaison to USAF GPSOC

- Attends Air Force Undergraduate Training for Space (5 wks)
- Provides the civil interface to GPS Operations Center.
- Works closely with DOD staff to monitor GPS satellite operations and maintenance to safeguard civil interests.
- Coordinate issue resolution between the GPS user and the DOD service providers.
- Supports civil users in resolving GPS outages by facilitating reports, coordinating findings, and disseminating results.
- Attends DOD Constellation Sustainment Assessment Team (CSAT) meetings to represent civil user input on GPS launch decisions.
Outreach

Annual meeting co-located with ION

Subcommittee Meetings:

• International Information Subcommittee (UK Chair)
  Annual European and Asia meetings
• Timing (BIPM Chair)
• Survey, Mapping and Geo-sciences (NGS Chair)
• States and Local Government (FHWA Chair)
  Two meetings annually in different cities around the country

Annual GPS Industry Partnership Day (LA AFB)

Conferences:

• Institute of Navigation (ION) GNSS Conference
• ION Joint Navigation Conference
• European Navigation Conference
• Munich Satellite Navigation Conference
Civil GPS Representation

NAVCEN provides for civil representation and advocates for civil use of GPS at government meetings:

- GPS Constellation Sustainment and Assessment Team (CSAT)
- GPS Interagency Forum for Operational Requirements (IFOR)
- Civil GPS Program Management Review (PMR)
- National PNT Engineering Forum (NPEF)
- DOS GPS International Working Group (GIWG)
- GPS Information Dissemination Coordination Team (IDCT)
- United Nations International Committee on GNSS (UN-ICG)
- DOT and DHS POS-Nav and Extended POS-Nav Committees
- GPS Joint Service Review
- Interface Control Working Group (ICWG)
Information Flow

• Performance Standard and Interface Control Documents (ICD) provide technical information necessary to build equipment.

  • IS-GPS-200 Navstar GPS Space Segment/Navigation User Interfaces
  • IS-GPS-800 Navstar GPS Space Segment/User Segment L1C Interface
  • IS-GPS-705 Navstar GPS Space Segment/User Segment L5 Interface
  • ICD-GPS-060 GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Interval (PTTI)

• ICD-GPS-240 details flow of operational information from 2SOPS to Triad.

• Triad operations centers disseminate information through a variety of web-sites and notification methods
The GPS Triad
Joint GPS User Support Service

USAF GPSOC (military)
FCC
PIRT
NTIA
USCG NAVCEN (surface)
US Department of Homeland Security
FAA NOCC (airspace)

Patriot Watch Customer Base/Users
Maritime Information Operations Center Responsibilities

- **24/7 Operation:**
- Web based Information Services
- Navigation Information Service (NIS)
- GPS Civil Interface
- Long Range Identification and Tracking (LRIT)
- DGPS Monitor & Control.
- Nationwide Automatic Information System (AIS).
GPS CIVIL NOTIFICATION

• The TRIAD uses working relationships with partners to disseminate operational information

• NAVCEN has working relationships with
  • Japan DGPS Center
  • GLONASS Analysis Center
  • Korea DGPS Center
  • Canada: Nav Canada
  • Trinity House, UK
  • Australia Air Services
  • Et al

• Information is shared when it indicates effect to systems operated by other countries or areas of responsibility held by these organizations.
GPS Civil Performance

- The TRIAD uses DOD developed tools to predict GPS performance impacts due to planned changes to the satellite constellation status.
- Enables prediction of Dilution of Precision (DOP); measure of GPS user accuracy.
- High DOP triggers a coordinated regional user notification:
  - Notice to Mariners (NTM)
  - Notice to Airman (NOTAM)
  - CGSIC List Server Membership
HDOP Hudson Bay 16Aug2010

UNCLASSIFIED
GENERAL INFORMATION ON GPS

The Global Positioning System (GPS) was designed as a dual-use system with the primary purpose of enhancing the effectiveness of U.S. and allied military forces. GPS is rapidly becoming an integral component of the emerging Global Information Infrastructure, with applications ranging from mapping and surveying to international air traffic management and global change research. The growing demand from military, civil, commercial, and scientific users has generated a U.S. commercial GPS equipment and service industry that leads the world. Augmentations to enhance basic GPS services could further expand these civil and commercial markets.

GPS is managed by the National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee, supported by the PNT Executive Secretariat (http://www.pnt.gov). The PNT manages GPS and U.S. Government augmentations to GPS, consistent with national policy, to support and enhance U.S. economic competitiveness and productivity while protecting national security and foreign policy interests.

The basic GPS is defined as the constellation of satellites, the navigation payloads which produce the GPS signals, ground stations, data links, and associated command and control facilities which are operated and maintained by the Department of Defense; the Standard Positioning Service (SPS) as the civil and commercial service provided by the basic GPS; and augmentations as those systems based on the GPS that provide real-time accuracy greater than the SPS. GPS permits land, sea, and airborne users to determine their three dimensional position, velocity, and time, 24 hours a day in all weather, anywhere in the world.

From our site, you may view or download current and archived GPS satellite information such as status messages, precise ephemeris data, and almanacs.

Specific, operational GPS information may be obtained from the links below or from the links on blue navigation bar at the left.

- Subscribe to the GPS Status Message and/or the NANU List Serve
- GPS Performance Reports (clicking on this link will open a new browser window showing the U.S. Air Force GPS Operations Center website)

GPS Status Messages

- Latest GPS Status Message
- GPS Status Message Archives

Report GPS Problems
RAA2012-002: Boston Light Buoy, GPS Outage
GPS Performance Analysis
0000z - 2359z, 09 Jan 12
Analysis Overview / Assumptions

• Location of Incident:
  – Boston Light Buoy

• Coordinates:
  – Location N 42.2282° W 070.4171°

• Date of Incident:
  – 2000z, 09 Jan 12

• Number of Incidents:
  – 1

• Mask Angle:
  – Visibility Charts - 0°
  – Contour and Spike Charts - 5°

• Caveats:
  – None
Summary of Findings

• GPS Performance:
  – Best-4 PDOP at 2000z, 09 Jan 12 in AOI was less than 3
  – Best-4 Position Error at 2000z, 09 Jan 12 in AOI was less than 3 meters
  – All In View PDOP at 2000z, 09 Jan 12 in AOI was less than 2
  – All In View Position Error at 2000z, 09 Jan 12 in AOI was less than 2 meters

• Satellite Outages:
  – No outages

• Solar and Geophysical Weather:
  – Energetic Events: Nothing significant
  – Proton Events: Nothing significant
  – Space Environment Analysis: Nothing significant
  – X-Ray Flux: Nothing significant

• EMI/RFI
  – No EMI/RFI events were observed at or near the locations in question.

• Other Analysis/Findings:
  – No other factors were found indicating a possible cause for loss or degradation of the GPS signal over the requested area.
PDOP Max | Best 4 | Boston Light Buoy
0000z-2359z, 09 Jan 2012

Contour Legend
Metric: PDOP Max
Start Time: 09 Jan 2012 00:00:00Z  Altitude: 0 ft HAE
End Time: 09 Jan 2012 23:59:00Z  Number of Channels: 4
Almanac File: current.ali
Latitude Increment: 00° 01.2'  Mask Angle: 5°
SOF File: 2011_364_062313_v02
Longitude Increment: 000° 00.66' Terrain Blockage Type: None
PAF File: 2012_009_v03.paf
Production Date: 01/13/2012 03:47:31
No Outages
Back up slides
• Protect the Nation’s 18 Critical Infrastructure & Key Resource Sectors
• System-of-Systems, open architecture, multi-phased/multi-layered approach
• Near real-time situational awareness of PNT Interference
  – Leverage existing mature capabilities & focus on the data, less on system/device
  – Common Data Structure for Information Sharing
  – Persistent monitoring for situational awareness
Mitigation -- Resiliency

• Master Clock Distribution via Optical Networks
  – Utilize existing fiber infrastructure
  – Successful prototype
  – Long-haul test between pre-determined sites to evaluate physical capabilities, baseline
  – Distribution of Master Clock to specific demarcation
Department of Homeland Security
PNT Program Management Office

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