Civil PNT Utilities

Civil GPS Service Interface Committee
U.S. States and Local Government Subcommittee
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- Official U.S. Government information about GPS and related topics
  - Systems Modernization
  - Applications
  - Governance
  - Presentations
  - International Activities
  - Technical Documentation
    - Federal Radionavigation Plan (FRP)
    - Interface Control Documents
    - Performance Standards and Specifications
    - GPS Satellite Simulator Working Group
    - Semi-Codeless/Codeless Civil Access Commitments
GPS is a Critical Component of the Global Information Infrastructure

- Satellite Operations
- Power Grids
- Personal Navigation
- Communications

- Disease Control
- Surveying & Mapping
- Oil Exploration
- Fishing & Boating

- Precision Agriculture
- Aviation
- Trucking & Shipping
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- Precision Agriculture
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- Trucking & Shipping

- Satellite Operations
- Communications
- Personal Navigation
FAA GPS Augmentation Programs

WAAS

Enroute Oceanic
Enroute Domestic
Terminal
Approach
Surface

LAAS

U.S. Department of Transportation
Research and Innovative Technology Administration
WAAS Architecture

- 38 Reference Stations
- 3 Master Stations
- 4 Ground Earth Stations
- (2+1) Geostationary Satellite Links
- 2 Operational Control Centers
Nationwide Differential GPS

- Expansion of maritime differential GPS (DGPS) network to cover terrestrial United States
- Built to international standard adopted in 50+ countries
National Continuously Operating Reference Stations (CORS)

- Enables highly accurate, 3-D positioning
  - Centimeter-level precision
  - Tied to National Spatial Reference System
- **1,800+** sites operated by **200+** public, private, academic organizations

- NOAA/NGS’s **Online Positioning User Service (OPUS)** automatically processes coordinates submitted via the web from around the world
- **NGS Real-Time GNSS Website** (beta version)
- **Leveling Online Computations User Service (LOCUS)** simplifies the office processing and adjustment of geodetic leveling
GPS-Based Applications are Critical to Major DOT Initiatives

**Aviation – NextGen**
- Reliable and accurate positioning worldwide
- Reduced delays
- More fuel-efficient routes
- Increased system capacity with enhanced safety

**Rail – Positive Train Control**
- Reduced probability of collisions
- Increased efficiency and capacity
- Rapid rail structure and conditioning mapping

**ITS/Connected Vehicle**
- Enable crash prevention among vehicles and between vehicles and infrastructure
- Increased mobility and reduced environmental impact
What Are We Trying to Get to?

• Intelligent Transportation Systems (ITS) Safety Applications for all Surface Modes of Transportation
  – Leverage technology to make vehicles discoverable to other vehicles, infrastructure, and pedestrians
  – Enable 360° situational awareness to the vehicle and driver

• Intelligent Railroad Systems
  – Increase track and locomotive safety
    • Positive Train Control
    • Track Defect Location
    • Automated Asset Mapping/Surveying
Where are State DOTs Trying to Get to?

- GPS Enforcement of Designated Truck Routes
  - Illinois State Legislature required study
  - Illinois DOT study makes eight recommendations for truck GPS systems
    - Vertical clearance
    - Weight restrictions
    - Communications and enforcement of truck GPS systems

- Automated Vehicle Location (AVL) Systems for Data Collection
  - 2011 VDOT Survey
    - Road weather management systems
    - Near-real-time road conditions
    - Mapping noxious weed control
    - Tracking incarcerated workers
Recent State and Transit Initiatives

• Arkansas State Highway and Transportation Department
  – Installing GPS devices in each of the Department’s 2,400 vehicles
  – First state agency to outfit all of its vehicles with GPS devices
    • Real-time vehicle diagnoses/immediate maintenance
    • Accountability for use, speed
    • Cost about $700,000; pay for itself in about eight months with fuel savings

• Washington State Ferries – largest ferry transit system in the U.S.
  – “Routine” maritime uses: vessel location, navigation, draft depth measurement
  – Recently added GPS customer services
    • Vessel Tracker (“Where’s Your Ferry?”)
    • Added GPS-derived estimated ferry arrival times, overlaid on tracking map
  – Researching Wireless-Over-Water (WOW) mobile safety and security application

• WashDOT Use of GPS Truck Data
  – Identifying and ranking traffic bottlenecks; performance measures
  – Real-time rerouting for freight movements around Port of Seattle
Easy to Purchase GPS Jamming Devices

- Growing market for low-cost GPS jammers
  - Concern over being tracked using GPS, particularly among those driving a company or fleet vehicle
- Many devices are battery-operated or can be plugged into a cigarette lighter
- Sold as “privacy protectors” or “personal protective devices”
January 13, 2012 National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee (EXCOM) co-chair letter to National Telecommunications and Information Administration (NTIA) proposed to draft new Global Positioning System (GPS) spectrum interference standards:

- Inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals.

- Ensure such proposals are implemented without affecting existing and evolving uses of space-based PNT that are vital to economic, public safety, scientific, and national security needs.
GPS L1 Signal Spectrum Use

MSS Band
(1525 – 1559 MHz)

GPS L1 Band
(1560 – 1610 MHz)

Radio Occultation
Scientific / Research / Environmental
Agriculture / Survey / ISR
Geodetic / Construction
Unmanned Aerial Vehicles (UAVs)
Certified Aviation / General Nav
Robust General Location / Navigation
Cellular / Other Narrow-Band

L1 C/A Code

L1 P(Y) Code

Frequency (MHz)

Notional – For Discussion Purposes Only (Not to Scale)
Illustration of Concerns with LightSquared

LightSquared Spectrum  
1525  1559
low power MSS emissions

GPS Spectrum  
1525  1559  1575  1610
Situation without LightSquared’s terrestrial network

situation with LightSquared’s terrestrial network

LightSquared  
Conflicts with GPS

> LSQ base station emissions

low power MSS emissions

GNSS receiver tolerable aggregate interference

GLONASS
DOT GPS Spectrum Protection Plan - Status

- Deputy Secretary Tasking to FAA and RITA:
  - Collaborate to develop a spectrum protection plan which provides a framework to define the processes and assumptions for development of GPS spectrum protection criteria on behalf of GPS civil users.

- GPS Spectrum Protection Plan will identify the processes for:
  - Deriving adjacent-band power limits, as a function of offset frequency, necessary to ensure continued operation of all applications of GPS services.
  - Determining similar levels for future GPS receivers utilizing modernized GPS and interoperable Global Navigation Satellite System (GNSS) signals.

- GPS spectrum protection criteria will ensure continued use of existing space-based PNT services vital to economic, public safety, scientific, and national security needs, while also considering modernized GNSS signals.
  - Criteria will Inform future proposals for non-space, commercial uses in the bands adjacent to the GPS/GNSS signals.