Civil PNT Utilities

Civil GPS Service Interface Committee
U.S. States and Local Government Subcommittee
Austin, TX
June 13, 2012

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GPS is a Critical Component of the Global Information Infrastructure

- Satellite Operations
- Surveying & Mapping
- Aviation
- Communications
- Precision Agriculture
- Disease Control
- Power Grids
- Trucking & Shipping
- Oil Exploration
- Fishing & Boating
- Personal Navigation
- Disease Control
- Oil Exploration
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
  – Assessing HA-NDGPS for meeting requirements
    • 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
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”
Affect of GPS Jamming Devices

RFI source “Locked-on” and pursued.

On Site ON-OFF tests confirms GPS RFI source.
DOT GPS Spectrum Protection Plan

- 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)
Non-Certified Aviation / General Nav
Certified Aviation
Robust General Location / Navigation
Cellular / Other Narrow-Band

L1 C/A Code

L1 P(Y) Code

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

LightSquared Spectrum

GPS Spectrum

Situation without LightSquared’s terrestrial network

LightSquared Conflicts with GPS

Situation with LightSquared’s terrestrial network

> LSQ base station emissions

low power MSS emissions

1525 1559 1575 1610

GLONASS

GNSS receiver tolerable aggregate interference

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