Civil PNT Policy and Utility

Civil GPS Service Interface Committee
U.S. States and Local Government Subcommittee
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GPS is a Critical Component of the Global Information Infrastructure

- Satellite Operations
- Power Grids
- Personal Navigation
- Aviation
- Communications
- Fishing & Boating
- Oil Exploration
- Precision Agriculture
- Surveying & Mapping
- Disease Control
- Trucking & Shipping
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Surveying, Mapping, GIS

- Surveying is essential to any new development
  - Electrification
  - Telecom tower placement
  - Pipeline installation
  - Dam construction
  - Port dredging

- GPS enables 2-5 cm real-time positioning accuracy (RTK)
  - Mm-level accuracy possible with post-mission data processing

- 100%-300% savings in time, cost, labor
  - Stakeless, paperless surveys
Construction, Mining

- Faster site preparation
- Enhanced management of assets, equipment
  - More efficient asset utilization
  - Less idling of workers, machinery
- Precise automated machine control
  - Up to 70% increased job site productivity
  - Saves time, fuel, and emissions
  - Reduces maintenance
  - Prevents accidents
- Automated, wireless job tasking
  - Smaller, more empowered workforce – no foreman
  - Real-time progress tracked remotely
Agriculture

- Improved management of land, machinery, personnel, time
  - Optimized placement of crop rows, seeds
  - Enhanced monitoring of crop yields, soil quality, problems
  - Automated, 24-hour operations using lighter equipment, less fuel, less labor
- Plant-specific applications of water, fertilizer, pesticides, herbicides
  - Up to 80% increase in efficiency
- Greater crop yields, profit margins
- Environmental benefits
  - Reduced chemical use
  - Precise leveling of fields reduces runoff
  - Strip tillage/no tillage releases less CO2
  - Reduced CO2 emissions from lighter, more efficient machinery
Timing

- GPS offers an inexpensive alternative to high-maintenance timing equipment, networks
- Synchronization, management of communication networks
  - Phones, pagers, wireless systems
  - LANs, WANs, Internet, satellites
  - Cell phone tower handoffs
  - Digital TV
- Financial transactions
  - Stock exchanges
  - ATMs
  - E-commerce
- Power grid management
  - Load balancing
  - Fault detection, location
Disaster Management

- Assists in disaster planning efforts such as flood plain mapping
- Structure monitoring
  - Lock and dams
  - Levees
  - Bridges
- Helps relief workers navigate disaster areas devoid of landmarks
- Facilitates containment and management of wildfires
- Enables disaster warning systems
  - GPS-equipped buoys for tsunami warnings
  - GPS ground networks monitor crustal motion, earthquakes
- Enables emergency response
  - E-911
  - NG-911 (text, video, Facebook, tweets)
Environmental Stewardship

- Climate monitoring
  - Sea level rise measurements
  - Ice sheet change observations
  - Atmospheric moisture profiles
- Reduced greenhouse gas emissions
  - Efficient routing of aircraft, trucks, and other vehicles
  - Reduction of vehicle fleet idle times
- Oil and chemical spill cleanup
  - Positioning, modeling of spills to guide remediation efforts
- Commercial fishing
  - Enforcement of fishery boundaries
- Forestry
  - Safe and efficient lumbering
  - Monitoring of illegal deforestation
- Harbor and inland waterway dredging
  - Maintain/improve transportation channels
  - Dredge and dispose
New Applications Appear Every Day

- Mobile applications
  - Location based services
- Localized GIS datasets
- Personal, pet safety
- GPS radio occultation
- Road use taxation
FAA GPS Augmentation Programs

WAAS

Enroute Oceanic
Enroute Domestic

Terminal
Non Precision
LNAV/VNAV
Cat I

Approach
Missed Approach
Cat II/III

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
- **1,500+** sites operated by **200+** public, private, academic organizations

- NOAA’s Online Positioning User Service (OPUS) automatically processes coordinates submitted via the web from around the world
- OPUS-RS (Rapid Static) declared operational in 2007
- NOAA considering support for real-time networks
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 States 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.
LightSquared – Current Status

- LightSquared agrees that transmissions in the upper 10 MHz channel—the channel nearest to the 1559-1610 MHz GPS band—will adversely affect the performance of a significant number of legacy GPS receivers, especially high-precision receivers.

- **LightSquared’s June 30 Proposed Solution**
  - First, it will operate at lower power than permitted by its existing FCC authorization.
  - Second, LightSquared will agree to a temporary standstill in the terrestrial use of its upper 10 MHz of its frequencies immediately adjacent to the GPS band.
  - LightSquared will coordinate and share the cost of underwriting a workable solution with GPS manufacturers of legacy precision measurement devices that may be at risk.
LightSquared – “Lower 10” Testing – NTIA

NTIA Letter of September 9 Sets Forth Parameters

• All parties Including LightSquared) agree that lower 10 operations will cause unacceptable interference to high-precision receivers
  - LightSquared is procuring a filter to mitigate impacts
  - LightSquared has acknowledged they will not begin operations until Federal agencies test the filter to determine effectiveness
  - No further high-precision testing now; wait until filter available

• Assessments of earlier test results on timing, aviation and space-based receivers continues; no further testing required

• Limited time and scope of earlier testing on cellular and personal/general navigation receivers results in call for retest
  - Limited to minimum number if devices necessary to provide validity of earlier testing
  - Retest of ten more susceptible receivers in lower 10, to determine if additional operational limits need to be imposed on LightSquared
  - Federal agencies may choose to add other devices for testing

• November 30 due date
LightSquared – “Lower 10” Testing – FCC

FCC Calls for “Lower 10” Testing in Public Notice on September 13

- Recognizes GPS interference results of first round of testing
- States early lower 10 MHz testing “showed significant improvement compared to tests of the upper 10 MHz”
- Recognizes “there continue to be interference concerns, e.g., with certain types of high precision GPS receivers, including devices used in national security and aviation applications
- Calls for focus on cellular and personal/general navigation receivers
- Does not set a firm deadline
LightSquared – Other Status

States and Localities:
• Significant response in opposition filed with FCC by August 15 deadline.
• Concern that Federal level not hearing state and local concerns, including lost services and efficiencies, and cost of re-equipage.
• Several have stated that “lower 10” operation will still harm states, especially the over 100 real-time networks upon which many rely.

Department of Transportation:
• Supports NTIA’s request to FCC for delay in approval until testing complete on “lower 10” scenario.
• Committed to working with all parties to find a technical solution that supports the National Broadband Plan and GPS safety requirements.

Dish Network Filing:
• Logic relies on LightSquared waiver; again not ancillary.
• Uses S-band [2GHz], not L-band, so no GPS issues.