# Civil PNT Policy and Utility

**Civil GPS Service Interface Committee**
**U.S. States and Local Government Subcommittee**
**Sacramento, CA**
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**Timothy A. Klein**
**Senior Policy Advisor / RITA NDGPS Coordinator**
**NDGPS@dot.gov**

# GPS is a Critical Component of the Global Information Infrastructure

Satellite Operations

Precision Agriculture

Surveying & Mapping


Aviation

Communications

Disease Control

Power Grids

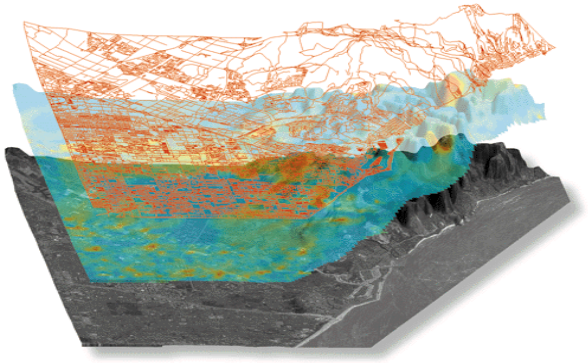
Trucking & Shipping

Oil Exploration

Fishing & Boating

Personal Navigation

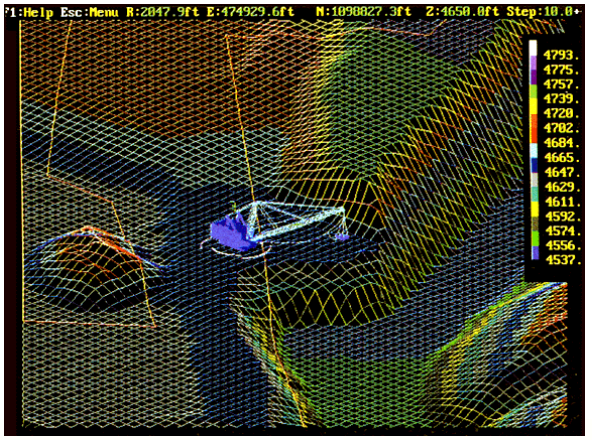
# Surveying, Mapping, GIS



- 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



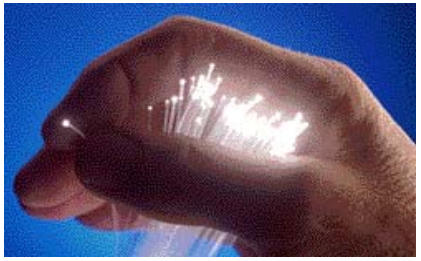
# Agriculture

- 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

This grain combine can be outfitted with a GPS receiver, yield monitor, and electronic sensors to track crop production based on location. These data can be transferred to a geographic information system to create a yield map and subsequently used to analyze the field and make site-specific management decisions.

# 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)

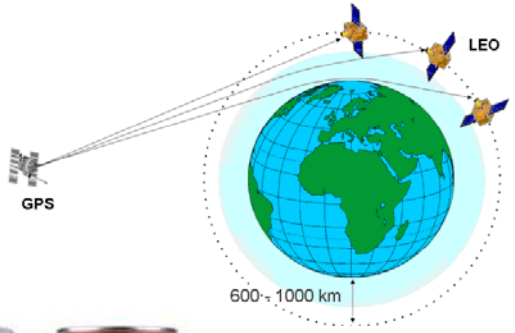
# Environmental Stewardship

- 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

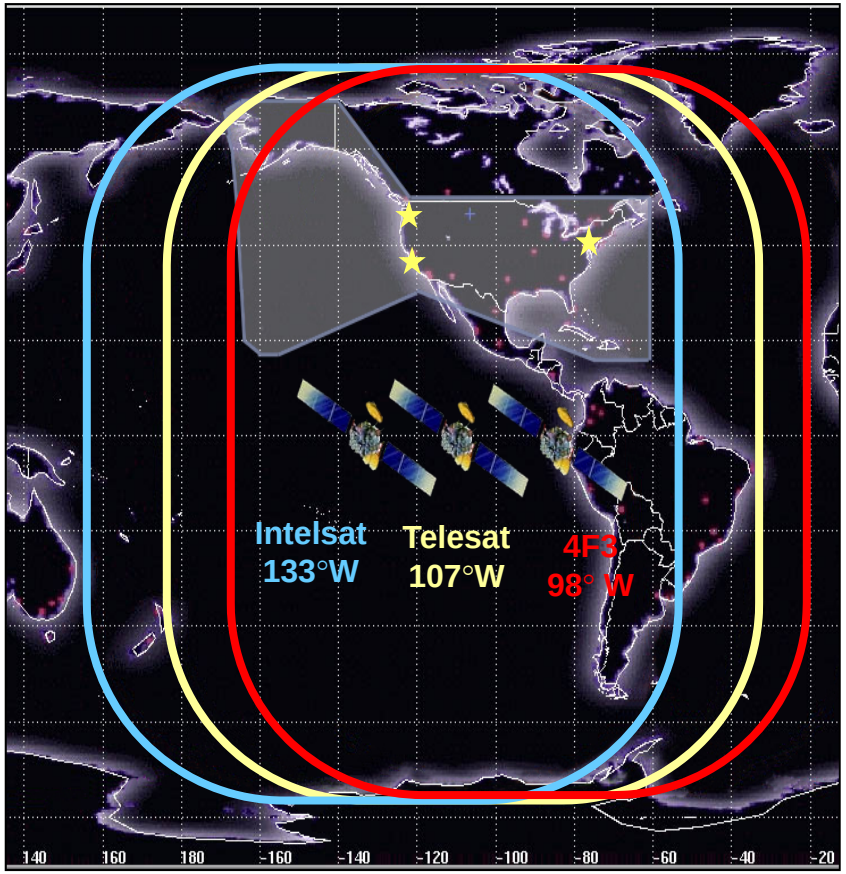
- Mobile applications
  - Location based services
- Localized GIS datasets
- Personal, pet safety
- GPS radio occultation
- Road use taxation






# FAA GPS Augmentation Programs

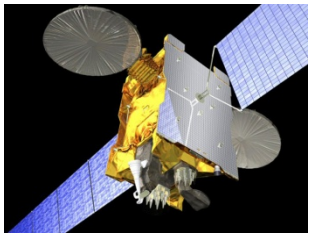
# WAAS Architecture



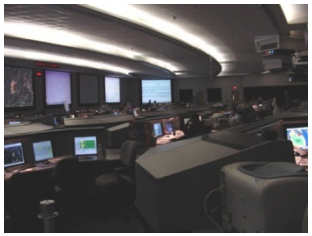

38 Reference Stations

3 Master Stations

4 Ground Earth Stations

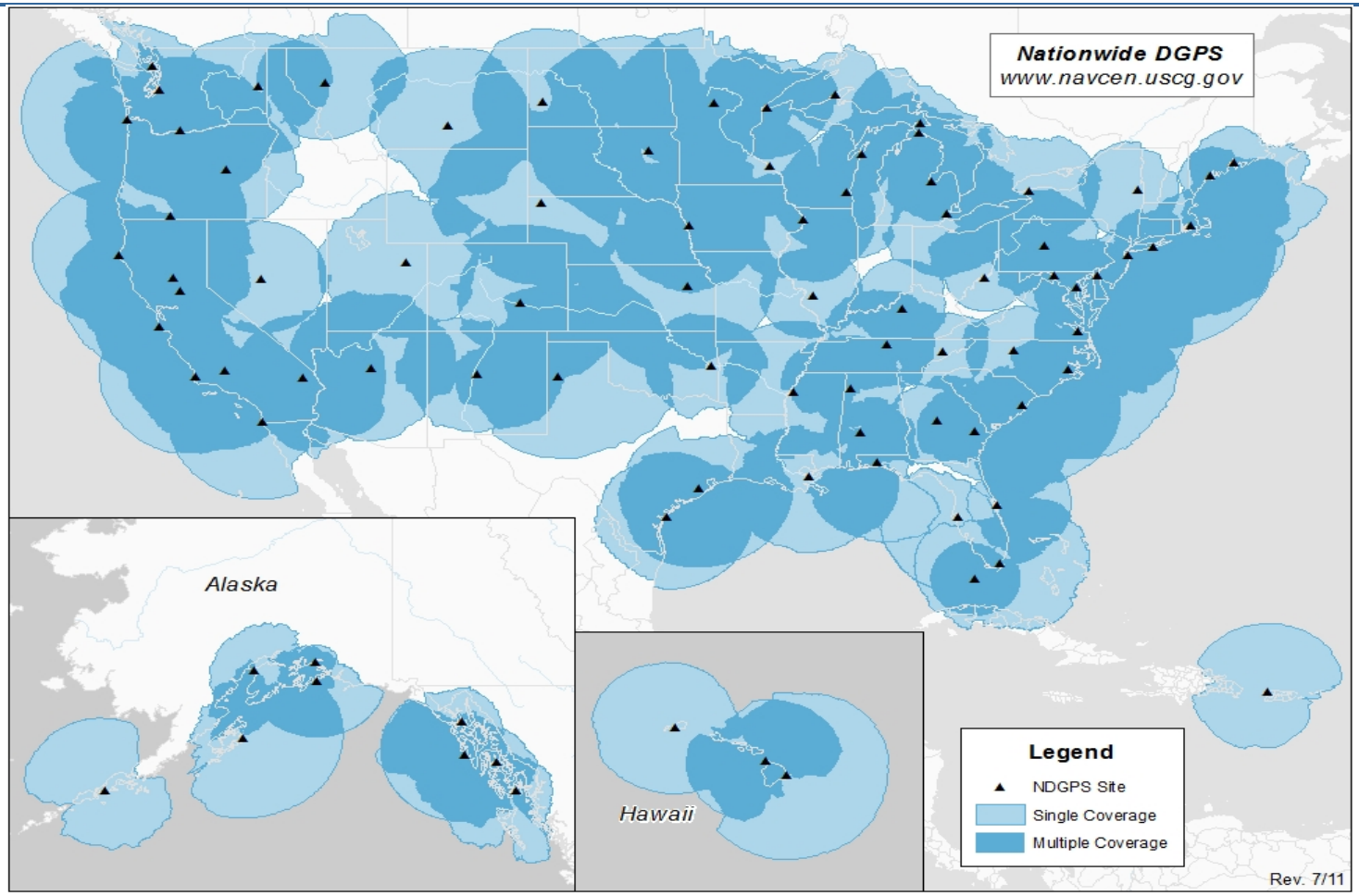


(2+1) Geostationary Satellite Links



2 Operational Control Centers

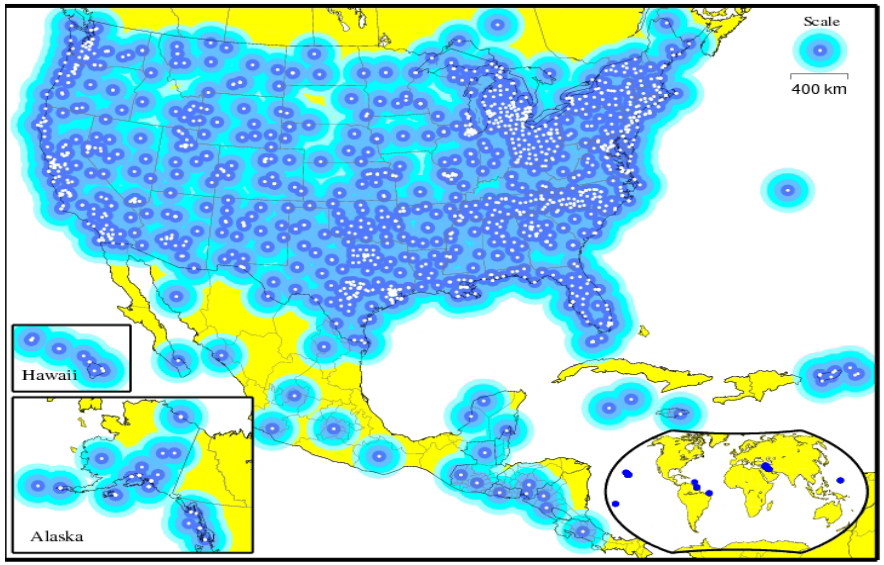
# Nationwide Differential GPS




- 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

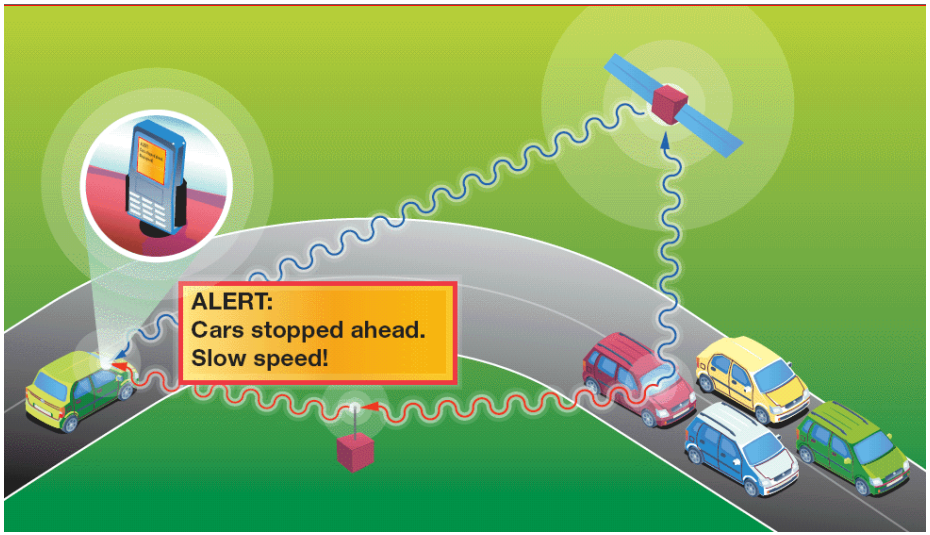
## ITS/Connected Vehicle

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”

**$99**

**$99**

**$320**

**$129**

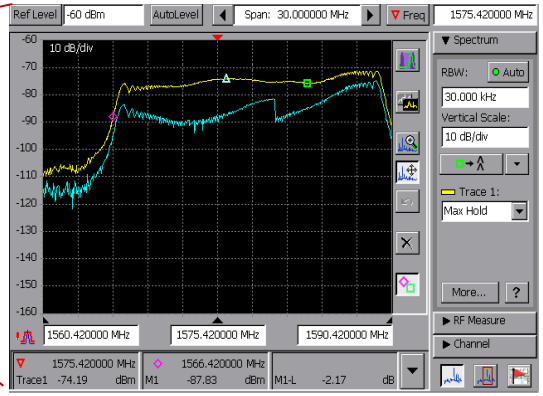
**$145**

**$30**

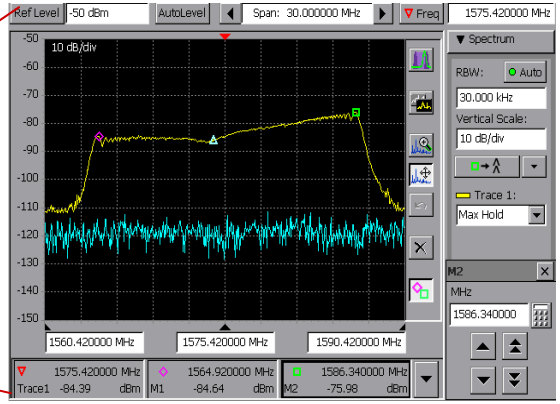
**$430**

**$79**

# Affect of GPS Jamming Devices




**RFI source "Locked-on" and pursued.**




**On Site ON-OFF tests confirms GPS RFI source.**

# LightSquared

- **The Way Ahead**
- 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.
- <u>LightSquared's Proposed Solution</u>

–First, it will operate at lower power than permitted by its existing FCC authorization.

- *LightSquared ATC stations during Las Vegas Live Sky Tests were transmitting at 10% of FCC authorized power (32 dBW). They intend to operate in the lower 10 MHz block of their network at this power level for an undefined period of time.*

–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 (2)

–Six months into the standstill period, LightSquared will commence a process of working with the Commission (FCC) and NTIA to explore options to enable mutual GPS and LightSquared operations at/near the band borders.“

•Third, LightSquared will commence terrestrial commercial operations only on the lower 10 MHz portion of its spectrum.

–They 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 still plans to use the lower 10 to deliver service within two years, much shorter than the projected time to research/replace high-precision receivers and dependent systems.

# LightSquared (3)

The Coalition to Save Our GPS States:

- Until it can be *conclusively shown that there will be no interference to critical GPS uses, LightSquared should not be allowed to deploy in the upper or lower MSS band.*
- The Coalition further notes that — *LightSquared already owns valuable high quality spectrum assets, including 59 MHz of nationwide ubiquitous spectrum in an advantageous frequency position."*
- On June 30 the FCC issued a Notice seeking public comment on the three LightSquared recommendations. Comments were filed by July 30 and reply comments by August 15, 2011.

# LightSquared (4)

## Projected transportation impacts:

- FAA/RTCA assessment projects over ten years –
  - $70 Billion impact to industry in re-equipage
  - Loss of 800 lives due to safety impacts
  - Significant NextGen delay, $17 billion cost

- FRA assessment projects over ten years –
  - Loss of $15 billion in productivity costs
  - Significant Positive Train Control delay; $5.3 billion cost

- MARAD assessment projects over ten years –
  - $30 billion in hull, cargo and oil pollution costs from ship groundings and collisions
  - Indeterminate loss of life, economic losses

# LightSquared (5)

## Projected transportation impacts:

- Highway/transit assessment projects over ten years –
  - $1.4 Billion impact to industry and state/local agencies
  - Loss of lives due to safety impacts
  - Significant ITS deployment delays, $2 billion cost

## 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:

- Relies on LightSquared waiver; again not ancillary
- Uses S-band [2GHz], not L-band, so no GPS issues