

Civil PNT Policy and Utility

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



Satellite Operations



Precision Agriculture



Surveying & Mapping



Aviation



Communications



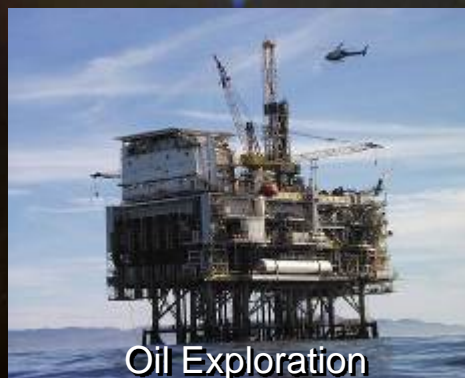
Disease Control



Power Grids



Trucking & Shipping



Oil Exploration

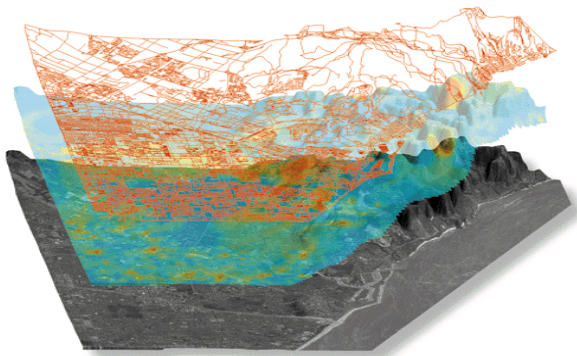


Fishing & Boating



Personal Navigation

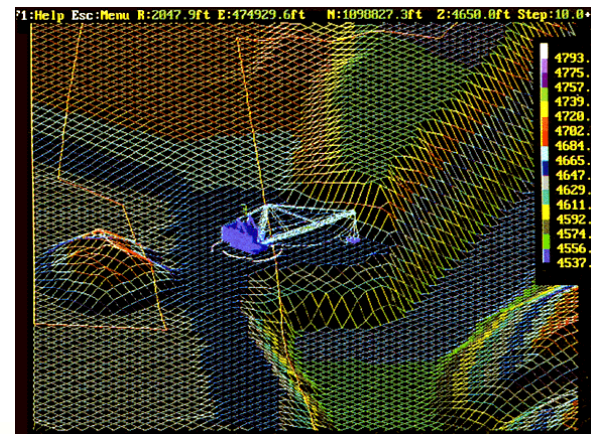
Surveying, Mapping, GIS



- 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)



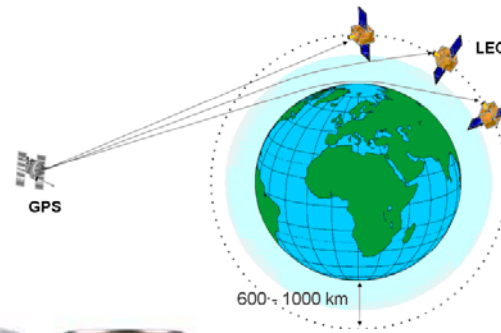
Environmental Stewardship

- 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



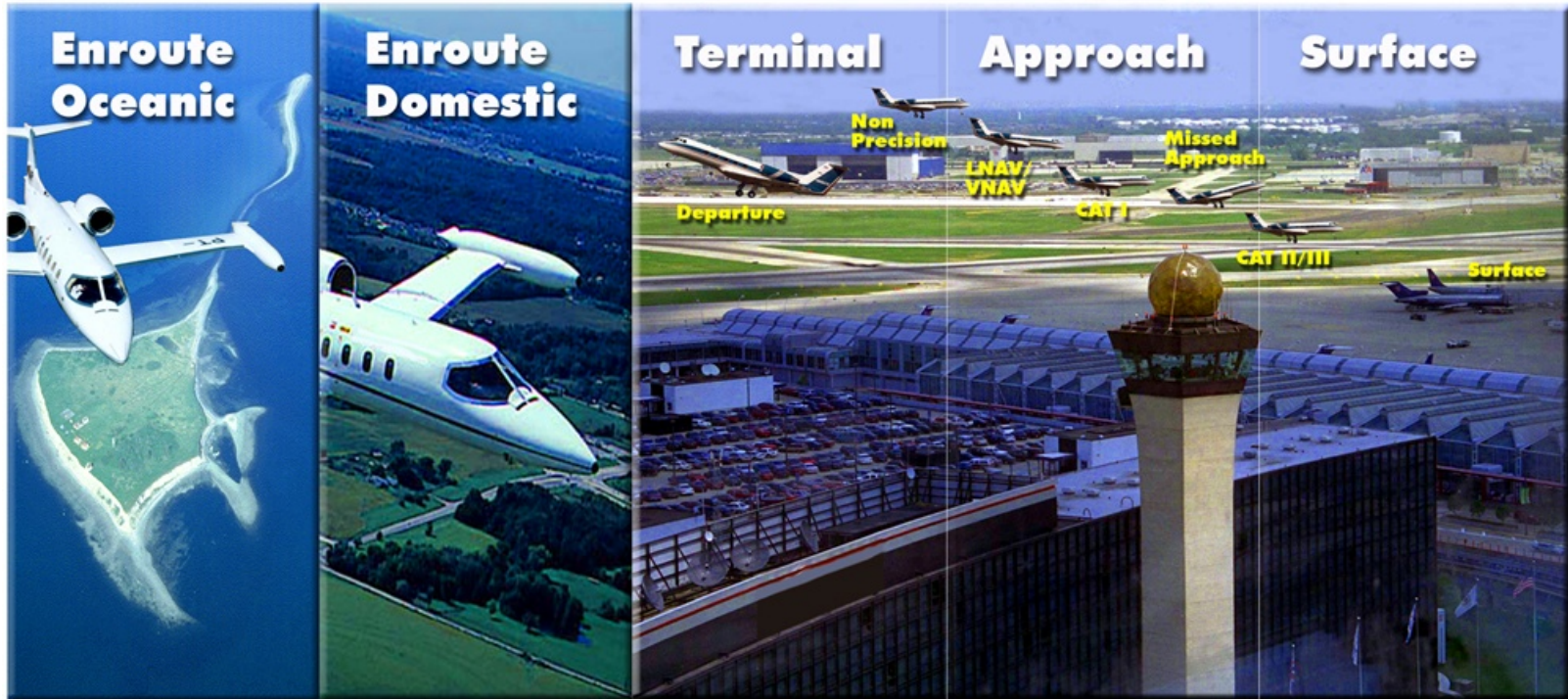
New Applications Appear Every Day

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



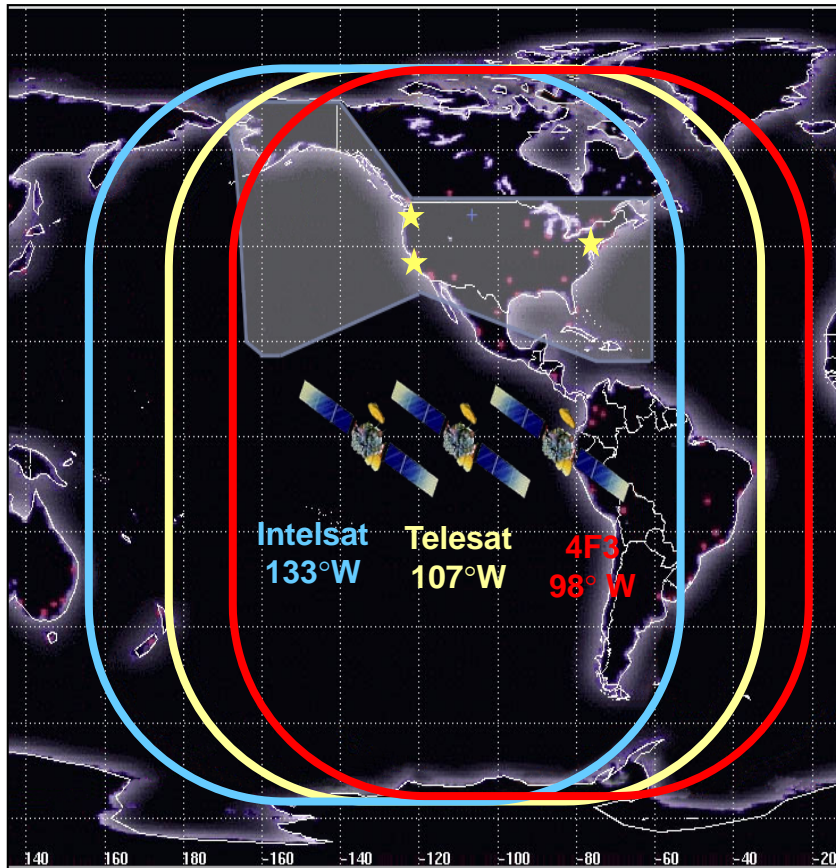
FAA GPS Augmentation Programs

WAAS



LAAS

WAAS Architecture



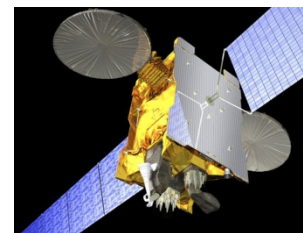
38 Reference Stations



3 Master Stations



4 Ground Earth Stations

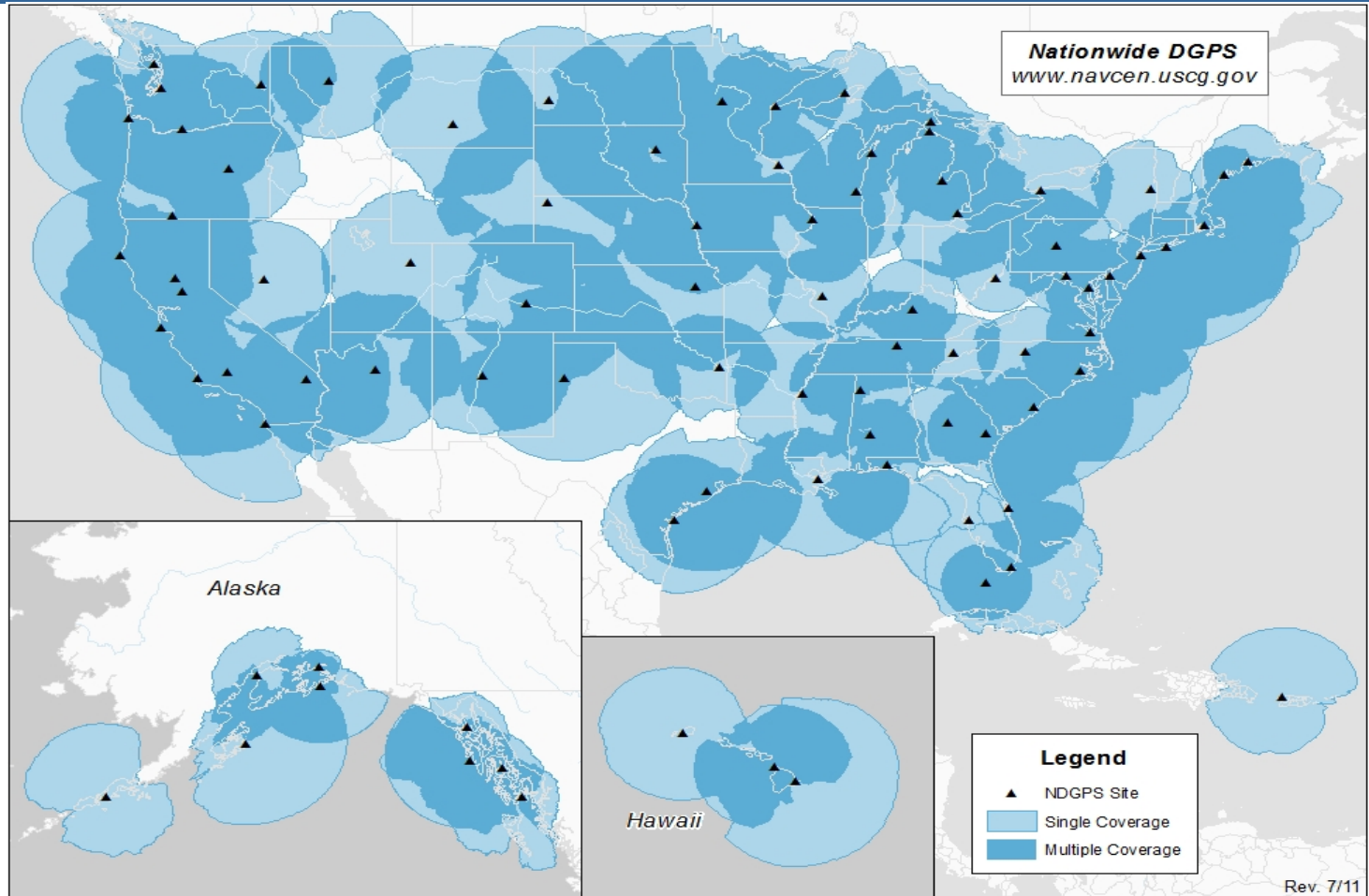


(2+1) Geostationary Satellite Links



2 Operational Control Centers

Nationwide Differential GPS

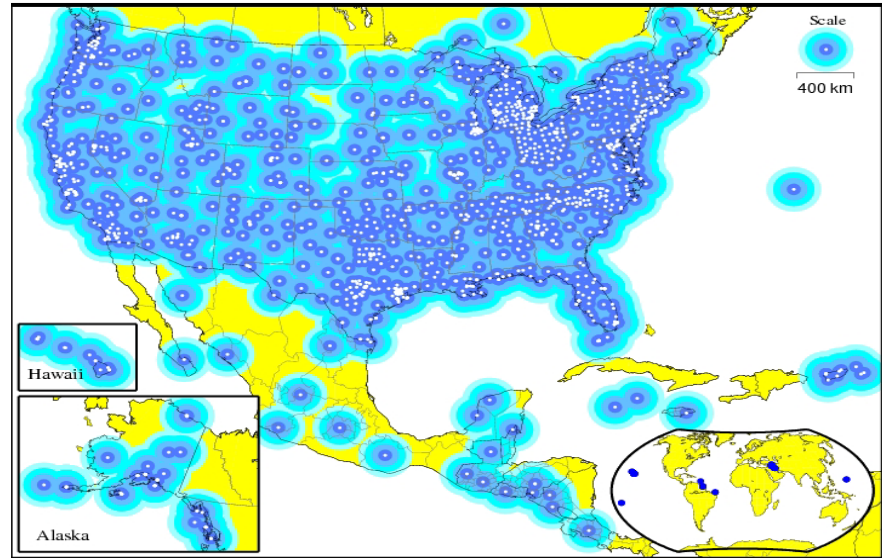


- Expansion of maritime differential GPS (DGPS) network to cover terrestrial United States
- Built to international standard adopted in 50+ countries



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

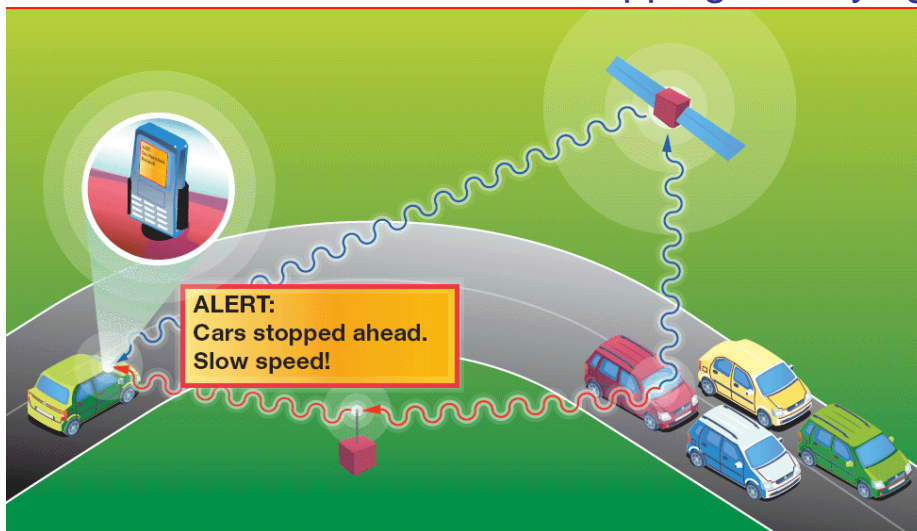
Enable crash prevention among vehicles and between vehicles and infrastructure

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



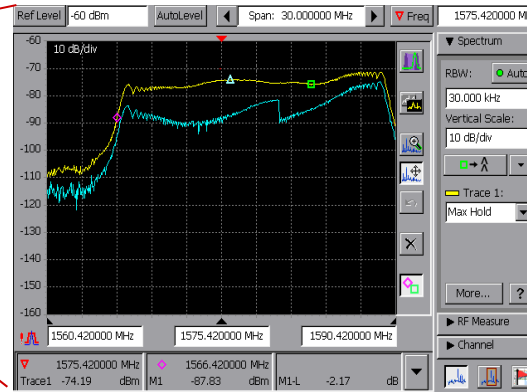
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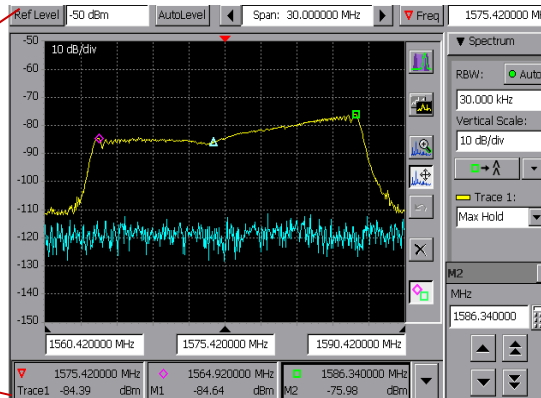
\$79



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 of 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