

Use Case Outreach – Federal Partners

- ❑ Worked closely with the DOT Extended Pos/Nav WG
- ❑ The WG members distributed a DOT GPS/GNSS use-case template to their respective departments and agencies
- ❑ The use-case template contained questions related to how DOT's federal partners operate receivers including make, model, and quantity deployed
- ❑ Responses provided by: DHS(CBP, ICE, TSA, USSS), DOC(NIST, NOAA), DOI(BLM, FWS), DOT(FAA, FRA, MARAD), NASA, DOT-CA, USDA
- ❑ Results from that effort were presented at the first Workshop (September 18, 2014 – Volpe Center Cambridge, MA)
 - http://www.gps.gov/spectrum/ABC/2014-workshop/Presentation3_Use_Case_v20140918_v1.pdf

Use Case Outreach – Industry

- ❑ Conducted outreach with manufacturers
- ❑ Provided a use-case template
- ❑ Manufacturers/Industry provided dedicated presentations on use case scenarios at workshop II & III (December. 4, 2014 & March 12, 2015 - Aerospace Corporation El Segundo, CA)
 - http://www.rita.dot.gov/pnt/gps_adjacent_band_compatibility_workshop/agenda2
 - http://www.rita.dot.gov/pnt/gps_adjacent_band_compatibility_workshop/agenda3

Incorporation of Use Cases

- ❑ Use cases will be used in conjunction with Interference Tolerance Masks (ITM) and propagation models to provide, on a single transmitter basis, the power levels that can be tolerated adjacent to GPS/GNSS signals
- ❑ Use cases are assembled from DOT's federal partners & industry responses and aggregated by six (6) GPS/GNSS categories:
 - General Aviation [non certified] (GAV)
 - General Location/Navigation (GLN)
 - High Precision & Networks (HPR)
 - Timing (TIM)
 - Cellular (CEL)
 - Space Based (SPB)

General Aviation (GAV)

Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
GAV	0	40k	920	Urban/Suburban/Rural	Flat/Sloped/Canyon – Open/Impeded - Land/Water	Yes/No	Variable

- ❑ In support of VFR flight operations
- ❑ Unmanned Aerial Vehicles (UAVs) are an emerging use case that can be greatly dependent on GPS. UAVs may operate in a variety of environments and terrain conditions.
- ❑ Types of vehicles: fixed wing, rotorcraft, UAS/UAV, balloon
- ❑ Electronic Flight Bag (EFB)

General Location and Navigation (GLN)

Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
GLN	0	1,000	600	Urban/Suburban/Rural	Flat/Sloped/Canyon – Open/Impeded - Land/Water	Yes/No	Variable

- ❑ Receivers may be permanently installed or portable
- ❑ Receivers can have close proximity to other wireless devices
- ❑ Use includes:
 - Marine: navigation and positioning, inputs to radar, command and control systems, and chart plotters
 - Automotive: cars, trucks, RVs, and motorcycles
 - Outdoor: search and rescue, hiking/camping, hunting, dog training, geocaching, golfing
 - Fitness: running, biking, and swimming
 - Asset/fleet tracking: boats/ships, cars/trucks, people, and cargo
 - Mapping/data logging: species, locating structures and boundaries

High Precision & Networks (HPR)

Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
HPR	0	20,000	180	Urban/Suburban/Rural	Flat/Sloped/Canyon – Open/Impeded - Land/Water	Yes/No	Variable

- ❑ Construction: planning, designing, building, and operating
- ❑ Agriculture: precision planting, growing, and harvesting
- ❑ Transportation and Logistics: fleet management
- ❑ Surveying and Geospatial: cadastral boundary surveys, engineering site surveys, project control surveys, photogrammetric surveys, science or any high accuracy projects, Mobile Terrestrial Laser Scanning (MTLS), wetland restoration design, fault line monitoring, and law enforcement
- ❑ Aerial remote sensing
- ❑ Mining
- ❑ Autonomous vehicle
- ❑ Rail
- ❑ WAAS Wide Area Reference Stations
- ❑ Space rocket launches and recovery

Timing (TIM)

Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
TIM	0	1000s	100	Urban/Suburban/rural	Flat – Open - Land	No	Fixed

- ❑ Financial
- ❑ Emergency services (e.g. E911), other communications
- ❑ Residual timing uncertainty of order 50 ps when the application is based on the phase of the carrier and approximately 1 ns when the application is based on the code. The corresponding uncertainty requirement in a frequency comparison is less than $5e-16$ "
- ❑ Provide western states and Alaska with information and forecasts of future water supplies. Collects data on local weather conditions at 150 stations located in 39 states
- ❑ Precision timing for IT equipment at datacenters, security command centers and for video editing
- ❑ Facilitate timing calibration on specialized transceiver units. GPS use is associated with Precision Time Protocol (PTP), as described in IEEE-1588

Cellular (CEL)

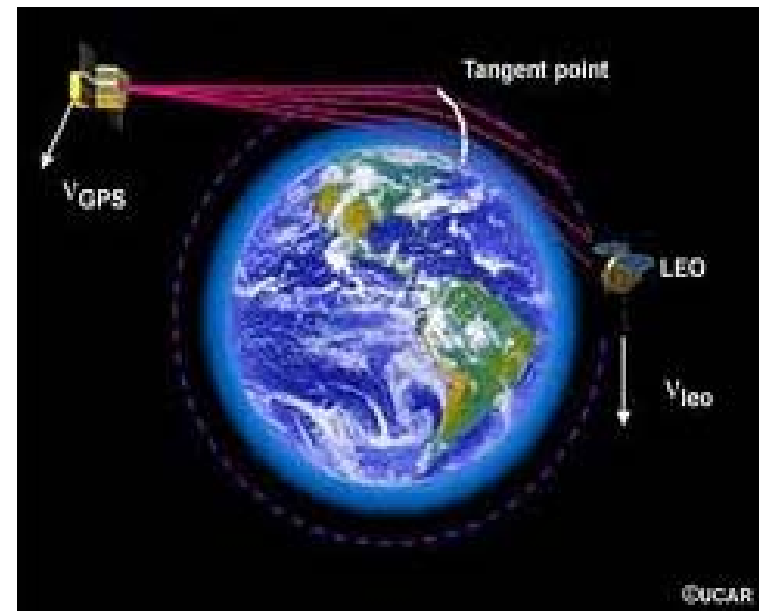
Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
CEL	0	100s	100s	Urban/Suburban/rural	Flat/Sloped/Canyon – Open/Impeded - Land/Water	Yes	Variable

- ❑ Cellular phones
- ❑ Automotive: cars, trucks, RVs, and motorcycles
- ❑ Outdoor: hiking/camping, hunting, dog training, geocaching, golfing, search and rescue (e.g. hiking)
- ❑ Fitness: running, biking, and swimming
- ❑ Asset/fleet tracking: boats/ships, cars/trucks, people, and cargo

Space Based (SPB)

Category	Height (feet AGL)		Speed (mph)	Urbanization	Terrain	Antenna Integration	Antenna Orientation
	Min	Max					
SPB	1,700k	4,300k	16k	n/a	n/a	No	Variable

- ❑ Space vehicle tracking and directivity
- ❑ Precise orbit determination
- ❑ Science based missions:
 - Radio occultation (GNSS-RO)
 - Weather forecasting
 - Climate change science
 - Space weather phenomenons
 - Reflectometry (GNSS-R)
 - Weather forecasting
 - Tidal surges
 - Flood plain monitoring



Radio Occultation CONOPS

Summary and Use-Cases Next Steps

- ❑ Due to the variety of applications within a category of receivers it suggests that a wide range of use-case parameter values can be used within each category

- ❑ Generally each category the range of parameters are:
 - Heights – 0 to 100s (if not 1000s) ft
 - Speeds – 0 to 100s MPH
 - Antenna orientations typically variable (except for TIM)
 - Urbanization - anywhere from urban-to-suburban-to-rural
 - Terrain – anywhere from Flat-to-sloped-to-canyon, open-to-Impeded, and land and/or water (except for TIM and SPB)

- ❑ The use case effort will next focus on further defining and finalizing the range of parameters within each category for the downstream analysis of determining tolerable transmit power levels. This is done by:
 - Seeking more information on the applications within each category to finalize a range of parameters within each category
 - Making use of receiver antenna measurements to have a representative pattern for each category of receivers
 - Identifying the number of transmitter use case applications and associated parameters that will be first assessed to determine transmit power level masks

- ❑ The framework to calculate allowable transmit power given use case parameters is discussed in the upcoming presentation.

Questions?