8. Transportation (Non-Aviation)

Overview

The use of GPS in surface transportation is estimated to exceed US$ 25 Billion annually. Every sector of surface transportation has become dependent on GPS.

Utilization and Benefits

Mapping and Guidance: Mapping such as Google and directions on internet, smart phones, and in-vehicle are used by businesses and individuals ubiquitously.

Portable navigation devices are affordable and widely available (image courtesy of Garmin Corporation).

Traffic Information: Traffic information is also widely available on the Internet, on smart phones, and on in-vehicle navigation units.

A free website provides real-time traffic information for Midwestern cities including Pittsburgh, Pennsylvania (image courtesy of localconditions.com).

Public Transit: Arrival times of buses and trains are widely available on internet, smart phones, and displays at stops. Public transit operators are using the GPS in their vehicles to improve vehicle dispatching, plan bus routes and vehicle maintenance, and send arrival times and traffic jam alerts to riders.

Bus shelters in Chicago provide arrival information based on GPS tracking of buses (photo courtesy of Ygomi LLC).

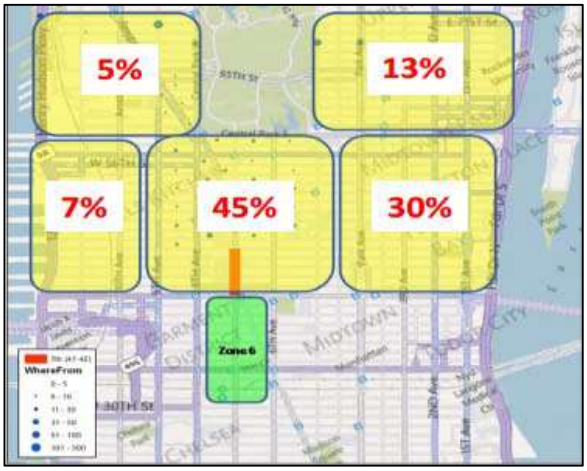
Vehicle Communications: In-vehicle telematics including automated emergency call are becoming widespread in new vehicles sold in the U.S. vehicle-to-vehicle (V2V) communications are planned to reduce vehicle accidents.

General Motors is one U.S. auto maker that is demonstrating V2V technology (photo courtesy of General Motors Corporation).

Automated Driving: Levels of automated driving in vehicles are being developed to reduce accidents and support people who have difficulty driving. These systems often include mapping and GPS.

A Chevrolet Bolt is equipped with sensors for development of automated driving (photo courtesy of General Motors Corporation).

Traffic Management: Traffic management authorities use GPS information to identify traffic patterns. Such data is used to plan road construction and maintenance, and set variable toll rates and speed limits.



For the Times Square Reconstruction Project in New York City, GPS-determined origin and destination zones (yellow) of taxi trips through the construction area (green) were used to identify likely detours while planning construction closures (image courtesy of New York City Department of Transportation).

Logistics: Freight handling companies are equipping vehicles and containers with GPS to improve efficiency and security. Uses include fleet management, load and delivery route optimization, real-time delivery assignments, and shipment tracking and monitoring.

Intermodal shipping containers on railway flat cars are tracked with GPS devices (photo by Tyler Silvest, licensed under the Creative Commons Attribution 2.0 Generic license).

Inland Waterway Transportation: The inland waterways of the United States include more than 25,000 miles of commercially navigable waters. River transportation is an important part of the integrated international multimodal transportation system. These waterways carry recreational craft as well as domestic and international cargo. GPS is the backbone of positioning, timing, navigation, tracking, and identification for the safety and security of river craft and infrastructure.

A single 15-barge tow, such as is common on the Upper Mississippi, is equivalent to about 225 railroad cars or 870 tractor-trailer trucks (photo by Ed Schipul, licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license).

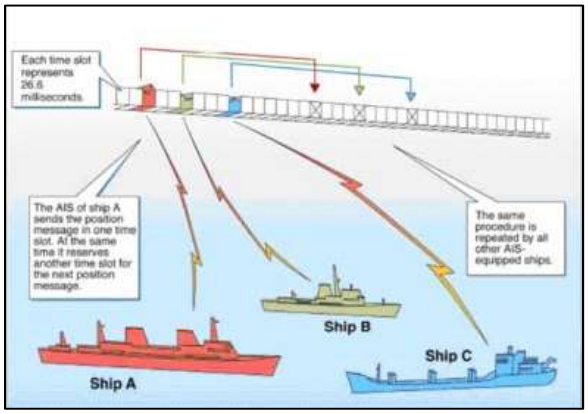
Maritime Transportation:

International maritime shipping is essential for global trade and for the global economy. Indeed, more than 80 percent of global trade relies on ship transportation. Maritime shipping provides a dependable and low-cost means of transporting goods globally, facilitating commerce, and helping to create prosperity for the nation.

Maritime shipping is the most energy-efficient, cost-efficient, and environmentally friendly means for the long-distance and high-volume transportation of goods, and is a key element for a sustainable global transportation system for U.S. business.

Safe and efficient navigation of ships depends on GPS during all phases of any voyage including oceanic passages, coastal approach, and entry into port. It is essential for route optimization, collision avoidance, emergency alert signals, search and rescue operations, and operating broadband ship communication systems. Ship management relies on GPS for purposes such as vessel monitoring, traffic management, fleet tracking, and management and national security purposes. GPS will play an enabling role in the development of future autonomous operations.

The TransAtlantic Lines ship MV TransAtlantic (photo courtesy of the United States Navy).



Position and timing information for an automatic identification system (AIS) is normally derived from an integral or external GPS receiver (graphic courtesy of the United States Coast Guard).

The U.S. is a signatory to the International Convention for the Safety of Life at Sea (SOLAS), which mandates a range of safety systems for ships, including those that depend on GPS for functionality such as AIS, voyage data recorders (VDRs), emergency positioning indicating radio beacons (EPIRBs), and the Global Maritime Distress Safety System (GMDSS).

GPS, increasingly accompanied by other GNSS systems, is in practice the sole source of PNT on board ships. GPS signal interference, whether intentional or unintentional, will thus greatly hinder maritime navigation and safety. GPS is essential infrastructure needed to maintain and further develop maritime shipping. GPS needs to be globally and continuously available, reliable, and accurate.

Threats

GPS and other GNSS are in practice the only source of PNT data for many land vehicles and ships. This presents a single point of failure.

Signal interference, intentional or unintentional, threatens all GNSS users. A conversion from satellite use to ground use of communications frequencies close to GPS would significantly degrade GPS in land vehicles. Spoofing and jamming are becoming true infrastructure threats, especially as connected and automated vehicles are rolled out.

Opportunities

Opportunities include emerging alternative backup capabilities for PNT and, also, more competent and robust receivers.

Recommended Actions

To protect the huge economic benefit of GPS/GNSS to surface transportation and other high precision applications, the PNTAB recommends the following:

- Keep spectrum for ground communication adequately distant from GPS spectrum
- Adopt approaches to harden GPS devices to recognize jamming and spoofing and counteract them
- Encourage GNSS manufacturers to offer more competent and robust receivers and antennas, and encourage product manufacturers to incorporate enhanced GNSS receivers in their products
- Encourage diversification of PNT sources. Have the FCC remove the requirement for licensing of non-Federal use of foreign GNSS
- Select and implement backup capabilities for GPS per NSPD-39

Summary

The use of GPS in surface transportation has become ubiquitous and of great economic benefit. It needs to be protected from the encroachment of more powerful signals in adjacent bands.