Ground Transportation Vehicle Tracking Technologies

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The last 5 years have generated more changes in activity and congestion on airport roadways, curb space and parking areas than in the previous 25 years. Airports are seeing rapid and significant changes in the business models used by commercial vehicle operators, the types of vehicles used, who is driving, activity levels, and changes in passenger's preferences for ground transportation options.

A significant part of these changes is from the introduction and improvements in available technologies that help airport management deliver better customer service while maintaining reasonably equitable treatment of the providers.

When an airport is contemplating a Ground Transportation Management system (GTM), a major consideration is tracking vehicles and/or drivers as they enter, pick-up, drop-off, move around, and exit the airport campus. By tracking this driver/vehicle data, airports can get extremely valuable insights into daily operations and long-range planning.

The question is: What tracking technology to use?

The answer, like most choices we face today is "it depends". Of course, this answer is not particularly helpful, so here's a proposed framework to help airports work their way through the decision process.

Technology Options

The good news is that Airports have several technology options, but before comparing the pros and cons of the various technologies, let's look at five key questions that likely drive an evaluation of the best tracking option for your needs:

1. Why is tracking needed? A GTM system can be used for a variety of purposes including improving roadway/curb congestion, automated dispatch, airport regulation compliance, and collection of trip-based fees. Is it important for you to track these types of things?
2. What to track? The technology is available to track the vehicle, the driver, or both. Which of these does your airport need?
3. Real-time vs. historical data? Some system uses (i.e. automated dispatch, balance tracking for trip fees, access control, etc.) require real-time processing of data, other uses such as monthly reporting can schedule transmission and processing of the data. What are your priorities?
4. Physical layout of roadway and curb? The complexity of the roadway system and curb locations will influence the equipment and infrastructure needs. Do you need multiple vehicle detection points?
5. Volume of activity? The number of drivers and/or vehicles to be tracked will also influence the technology decision. Do you have a high, medium or low volume?

Tracking Technology Options

Several primary technologies are currently available to monitor/control the movements of commercial vehicles/drivers on or off airport property. Each can be an effective solution, but each has a set of attributes that demand consideration when choosing the option that is best suited for your airport's needs. The following is a summary of the vehicle tracking technology options:

1. **Bar Code.** First to be used in early GTM systems due to its very low cost and ease of deployment. However, its relatively short read distance and rapid deterioration in weather limit its continuous use for GTM systems.

2. **Proximity Cards.** Wide adoption in parking systems (primarily employee and tenant parking). While it typically has a longer read range than does bar code technology and is more durable, it requires the vehicle to be stopped and the driver to accurately position the card next to the "reader". In the past the cost of the tag/card has been lower than RFID (#3 below), but recent technology advancements in RFID have almost eliminated this cost differential.

3. **Radio Frequency Identification.** Characterized by accurate detection at longer range and greater speeds than bar code or proximity cards. Over the last 25 years it has been the choice of airports in more than 90% of GTM systems installed in the US. It is still the technology of choice for many; however, new technologies have gained momentum due to some significant benefits (see sample sticker type RFID tag and "reader" unit in Figure 1).

4. **Low Energy Beacons.** One of the newest technologies to be used for tracking. This technology was developed for a wide variety of consumer marketing products, but it is being adapted for tracking vehicles in much the same way as RFID: place a device (Beacon) in each vehicle and install one or more detection devices (Sensors) where you want to detect a vehicle. Advantages include a much larger detection area that eliminates the need for a vehicle to "pass" a sensor, and almost no infrastructure requirements. Still in the early adoption stage, this technology holds significant promise.

5. **License Plate Recognition (LPR).** Creates images of each vehicle that passes the camera and then interprets the alpha and numeric characters which make up the unique ID on the vehicle's license plate. This unique ID is then used in the GTM system to track the movement of the vehicle. It is used in a large number of Parking Revenue Control Systems (PRCS) at airports and is likely to be used more extensively in GTM systems in the future. The accuracy of vehicle identification was less than expected in many of the early systems (e.g., less than 90% of all characters on the plate license plates were accurately read or interpreted), but technology advancements have now made this a more viable option.

6. **Global Positioning System (GPS).** Widely available to track the movement and location of vehicles. It is based on the use of messages from a smart phone or a dedicated GPS device installed in the vehicle (sample shown in Figure 2). In either case, messages are created and sent from the vehicle on a frequent basis. Special messages are sent for "events" such as a passenger pick-up or drop-off. This is being used by airport operators to track, generally in real-time, the movement of commercial vehicles.

Airports have multiple objectives and requirements for the tracking of commercial ground transportation vehicles and drivers, so they likely will use multiple technologies in a GTM system to take advantage of the benefits of each and eliminate or reduce their limitations.

One example of this approach is for an airport to use RFID technology as the primary source of tracking vehicles and calculating fees and then using GPS technology to track Transportation Network Company (TNC) vehicles. The message data from all tracking sources is sent to the same software.

The selection of the proper vehicle tracking technology will have a major impact on the cost of a Ground Transportation Management (GTM) system and its ability to produce the desired results. When analyzing the cost and benefits of a GTM system for your airport it is worth considering the "useful life" of the system. While no system lasts forever, our experience is that you can expect 10 to 15 years of use from the system with normal maintenance. The components have few moving parts to wear out and the software is updated regularly with new/improved functions. This makes the cost of the system more of an investment that will increase in value over time.

Tracking Technology Comparison [1]

This table compares the major attributes of the primary vehicle tracking technologies. A word of caution: Ratings for each attribute are generalized and not absolute. For example, RFID is not always more expensive than GPS or Beacons will never require infrastructure. For this reason, we have not attempted to quantify the total cost of each type of technology. Costs can be more accurately estimated after selecting which are best for your requirements.

Vehicle Tracking Technology Comparison				
Attribute	**Technology**			
	RFID	**ANPR/LPR**	**GPS**	**Low Energy Beacon**
Additional Physical Credential Required- Vehicle or Driver	Yes	No (License Plate)	No	Yes
Electronic Credential (Software, App)	No	No	Yes	No
Credential Cost-per vehicle	$10 to $20	None	Typically free	$75
Credential Format	1″ x 3″ sticker	N/A	N/A	2″ x 3″ x 1″
Credential Battery	None	None	None	Replaceable-2 yr.
Hardware Maintenance	Biannual	Biannual	None	Bi-annual and Battery Replacement
Detection Device Required	Yes (Reader/ Antenna)	Yes (Camera)	N/A	Yes (Sensor)
Infrastructure Required	Yes (Mounting, power, communications)	Yes (Mounting, power, communications)	none	Yes (Mounting, power, communications)
Infrastructure Cost	Significant	Significant	None	Low
Access Control Function Capable	Yes	Yes (Need additional hardware)	Yes (Need additional hardware)	Yes (Need additional hardware)
Detection Distance	Up to 18 feet	Variable (Greater than RFID)	N/A	> 250 feet
Detection Speed	High and low	High and Low	High and Low	High and Low
Detection Accuracy	99.90%	Variable (Depending on several factors. 85%+)	Variable (Not able to distinguish height- elevated roadways)	90%+
Tamper/Abuse	Some Concern	Low	Some Concern	Some Concern
Enforcement	Some effort required	Update & Monitor for new license plates	Need for ongoing Enforcement plan and manpower	Some effort required

[1] *This table was originally created by Gatekeeper Systems and included in the Airport Cooperative Research Program Report #146 "Commercial Ground Transportation at Airport- Best Practices". It has been updated and modified for this article*

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Notes:

- GPS comparison information assumes an app on the driver's phone, not a dedicated GPS device.
- Data is averaged, not exact.
- Enforcement is an issue for all systems, but the amount and type are different.

Conclusion

In summary, the need for more comprehensive information on the use of your roadways and curb space has never been more critical to your airport and is likely to be more complex in the future. At the same time, the technology that is available to capture the needed information and help you improve the day to day management of your ground transportation program has made significant progress in improved functionality and is now more cost effective than ever. Perhaps the most important take-away is that airports no longer need to select one tracking technology for all vehicle categories. This opens up the uses of a GTM system and makes them even more valuable.