WHITE PAPER

A Complete Golf Cart Tracking Solution

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1 Industry Background

1.1 Market Needs

Golf cart fleets require ongoing maintenance and monitoring. If properly maintained, they can be very reliable and provide years of service. But, without the right systems in place, managing an entire fleet of carts can be a burdensome task. Golfers can enter/exit restricted locations on the course, batteries can die in the middle of a round and rate of play can be adversely affected if cart whereabouts are not properly accounted for. New radio developments are making cart tracking systems technologically and financially feasible and Raveon has a solution that is sure to exceed competitive systems in both price and reliability.

1.2 Competitive Systems/Technologies

There are various solutions on the market for tracking golf carts. The main wireless platform in use today is cellular and the majority of solutions providers cater their systems (and pricing model) around this technology. Many of the current solutions are a SaaS (Software as a Service) model whereby the customer pays a monthly fee to maintain and operate their system. Cellular solutions are powerful but costly.

While there are many nice features to the cellular systems, the cost-reward tradeoff becomes important to analyze. The cellular systems provide many nice-to-have features such as ordering food and beverages, player communication, etc. at the cost of anywhere from $30-$50 per month per cart. This can add up quickly with an entire fleet of carts and, while possible, it may be hard for certain courses to find the immediate ROI when investing in such a system.

1.3 Raveon's Solution

Raveon has a unique solution in the golf cart tracking market. With an emphasis on providing a reliable and affordable system, Raveon's solutions help solve the core issues of cart ownership without some of the bells and whistles that the cellular solutions offer.

Raveon's wireless technologies are based on private networks. Our customers buy the end nodes (for each cart) along with the central base station (typically located at the clubhouse) so they control and maintain the system with the added benefit of no monthly fees and full control/security over the system. A Raveon system provides the following benefits:

- **Low cost**: Lowest overall cost of ownership compared to competitive systems
- **Real-time tracking**: 1-60+ second updates
- **No monthly fees**: one-time payment for the hardware/software package
- **General purpose inputs and outputs**: various GPIO for reading things like battery voltage and controlling features such as buzzers or alarms.
- **Long range**: Raveon's golf cart transponders are designed to reach distances of 2-15 miles depending on terrain. It is also possible to extend coverage by adding more base stations.

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2   Hardware

Raveon's system consists of a central base station and various end nodes on the carts. The end nodes all communicate to a base station which then relays messages to other end nodes if necessary. This star network topology can be extended with additional base stations if coverage is an issue (many hills, trees or valleys).

2.1   End Nodes

Raveon offers various radios for use with golf cart tracking systems. From modules to fully enclosed radios, medium range to long range, Raveon customizes each system to fit the particular course requirements. The following end-nodes are fully compatible, so if a particular user wishes to outfit their carts with the M22 (shown below) and track other assets with the more mobile V-50 (shown below), they can coexist and use the same base station.

2.1.1 Modules

For custom systems that require only wireless connectivity, Raveon recommends the following radio module, the RV-M50. This module can be ordered with or without GPS functionality. The RV-M50 OEM module allows you to incorporate connectivity and GPS Tracking into your system with the smallest footprint.

RV-M50

The RV-M50 is a LoRa-based based radio module.

- Low power: less than 50uA in sleep mode
- Long range: 2-15 mile range (1/2W max)
- Onboard GPS module
- Low cost
- 2 digital inputs, 1 high-current digital output, 1 analog input

2.1.2 Enclosures

"The RV-M50 module is available in two optional enclosures to create a full radio device that is easy to install into your golf carts.

Tech Series

The Tech Series enclosures house Raveon's radio modules. The RV-M22 case fits the RV-M50 radio module and has modular front panels to make it easy to cater to various connection methods (USB,

RS232, RS485, GPIO, etc.). There is even an Arduino option if the user wants to add their own custom application code to the device.

RV-V50

The RV-V50 is a plastic enclosure that includes a Li-ion battery and an onboard GPS antenna. This enclosure fits the RV-M50 radio module and includes an SMA RF antenna connector, a weatherproof power/communications connector, a power/function switch and 2 LEDs for battery and status feedback.

2.2 Base Stations

The base station is the central point for communications. In a golf cart tracking system, this would typically be located at the clubhouse or central IT location. An antenna would be located on a nearby roof with an RF cable (the shorter the better) connecting the antenna to the base station.

RV-M50

For smaller systems (<200), an M50 radio in a Tech Series RV-M22 enclosure is sufficient as the base station. This helps to reduce costs and has sufficient bandwidth for smaller systems.

RV-R40 or RV-R50

For larger systems, Raveon recommends the RV-R40 or RV-R50 base stations. These units include a base station controller which can handle multiple radios transmitting at one time. The RV-M50 can only receive one channel at a time but the RV-R40/RV-R50 can listen to over 50 transmissions simultaneously. For systems larger than 100 radios Raveon recommends the RV-R40 gateway.

2.3 Accessories

To form a complete system, a systems integrator must consider the necessary accessory items to compliment the radios. These accessories are outlined below.

2.3.1 Antennas

Choosing the right antenna for a particular application is paramount when it comes to creating a reliable wireless system. Raveon provides the following antennas for golf cart tracking applications.

Cart (RT-A-915-5)

For roof-top golf cart mounting in a 900MHz ISM system, The RA-xxx-xx-xx antenna is ideal. There is a threaded mount which allows an inexpensive, reliable and simple install process. The installer simply drills a hole in the roof, slips the wire through the hole, inserts the antenna into the hole and tightens down with the supplied nut. Then, the wire can be secured with wire ties or such.

Cart (RT-AN-GP2)

Each cart being tracked will also need a GPS antenna. The RT-AN-GP2 is ideal for golf cart installations as they are easily mounted with a through-hole screw mechanism.

Base station (RT-A-915-1)

The base station is typically located at the clubhouse or another high point in the system. The higher the antenna, the more reliable the coverage. The antenna is usually mounted to the roof with a coax cable that runs down to the radio. This way, the radio can be installed inside, away from the elements, and close to the server or computer used to process the tracking information. The recommended antenna for the base station is shown to the right. For added safety, a lightning arrestor should also be added in the cable path between the base station and the associated antenna.

3   Software

Raveon has teamed with GPSWOX to offer a complete tracking solution. Raveon provides the radio system hardware and GPSWOX offers an inexpensive web app that can also be purchased as a hosted solution with a one-time fee. This software pairs seamlessly with Raveon's hardware and the protocol has already been integrated. GPSWOX has all of the necessary features for cart tracking including:
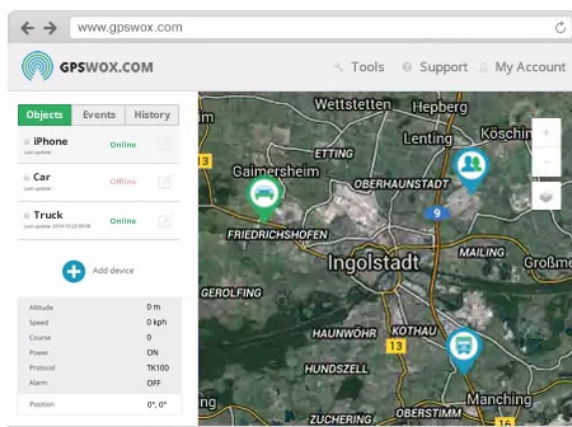
Real-Time Tracking

Track the location of your objects (vehicle, person, mobile, bike etc.) online in real-time. Choose from the following maps: Google, Satellite, OSM etc. View additional information about the tracking objects: speed, exact address, petrol consumption, travel history etc.
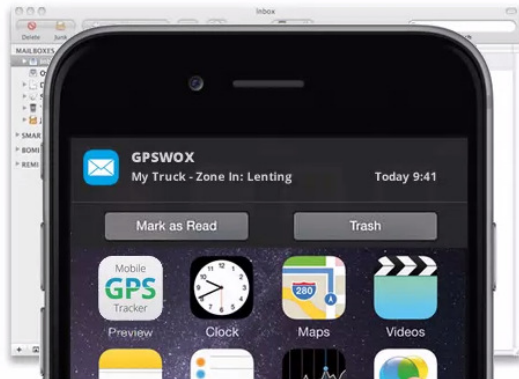
Notifications

Get instant alerts about your tracking object: know when the object enters or exits geo-zone, know if it is speeding and stopovers. Get SOS alarms if it has been stolen as well as turn on/off the engine easily. Get notifications to your iPhone, Android or Windows devices, via e-mail, mobile App or SMS.
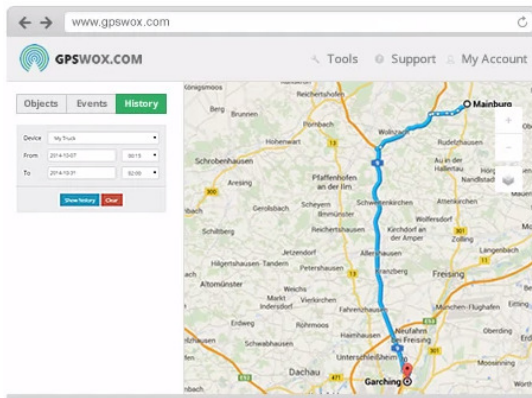
History and Reports

Download and review reports in different formats: XLS, PDF, CSV, TXT. Reports include various information by date and GPS tracker name including: driving hours, stopovers, distance traveled, fuel consumption and many more. Detailed and group reports are also available.
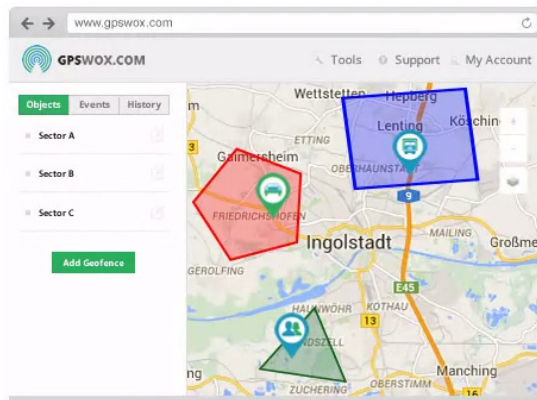
Geofencing

Geofence feature allows to set up geographic boundaries around areas that have specific interest for you. Receive automated alerts when the object enters or leaves marked boundaries.
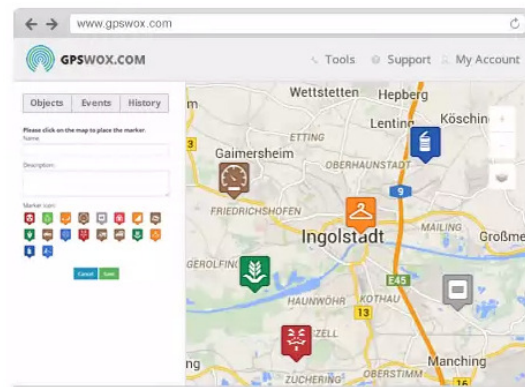
POI & Tools

With Points of Interest (POI) tool you can add markers at the locations, such as: gas station, a hotel, a restaurant, etc. Also, you can name the place and add description. You can also use tools for calculating distances between places on the map.

4   Raveon Technologies

Raveon designs radios for various industries and systems. Based out of Vista California, Raveon has been designing reliable wireless radio products for over 10 years. With various off-the-shelf options, Raveon provides solutions for a number of industries but also designs custom systems for certain customers. Check out the following websites related to Raveon's products and solutions:

www.raveon.com

iot.raveon.com

www.ravtrack.com

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