

The TrimTrac Locator: A New Standard in Practical and Affordable Asset Tracking

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Introduction

Until recently, vehicle-tracking devices have been designed to be intelligent and rugged, and have been deployed in high-end commercial applications. They have also been expensive, with costs ranging from \$500 to several thousand dollars. The TrimTrac™ locator is the first in a new line of low-cost tracking devices that are enabling a mass market to benefit from affordable vehicle monitoring and security services. As a position sensor, the device combines GPS positioning with wireless communication reporting. Its capabilities satisfy a wide range of vehicle monitoring and recovery needs that require periodic position updates, rather than continuous guaranteed delivery updates using high-bandwidth global connectivity.

The TrimTrac locator's development coincides with the rapid reduction in wireless communication costs in recent years. When costs were high, it made sense to build complex, intelligent vehicle devices that performed multiple functions within the vehicle. The downside of this approach was the high cost of the devices, including installation and maintenance, which were non-trivial expenses. With today's low-cost wireless communications, there is an opportunity to provide an affordable device that reports periodically and inexpensively to a server application.

The TrimTrac locator is derived from time-tested Trimble GPS technology used successfully by leading automotive manufacturers in their own in-vehicle navigation and telematics systems. It is the result of several million dollars in research and development to integrate the positioning and communications functions onto a single board with all functions using a common microprocessor. This level of integration not only improves power efficiency and enhances functionality and reliability, but it also dramatically reduces the device's cost. What is most compelling is the high degree of the TrimTrac locator's functionality compared with alternative devices that cost significantly more (see Figure 1). The TrimTrac locator's initial low cost and cost-effectiveness over time will open new markets by making vehicle tracking, security and recovery affordable to a greater number of consumers. Existing subscribers who are using more expensive in-vehicle services may be tempted to switch to a more affordable system based on the TrimTrac locator, especially if the TrimTrac locator is used to enhance the richness of existing in-vehicle services. Additionally, as the total cost of ownership decreases, new markets will emerge.

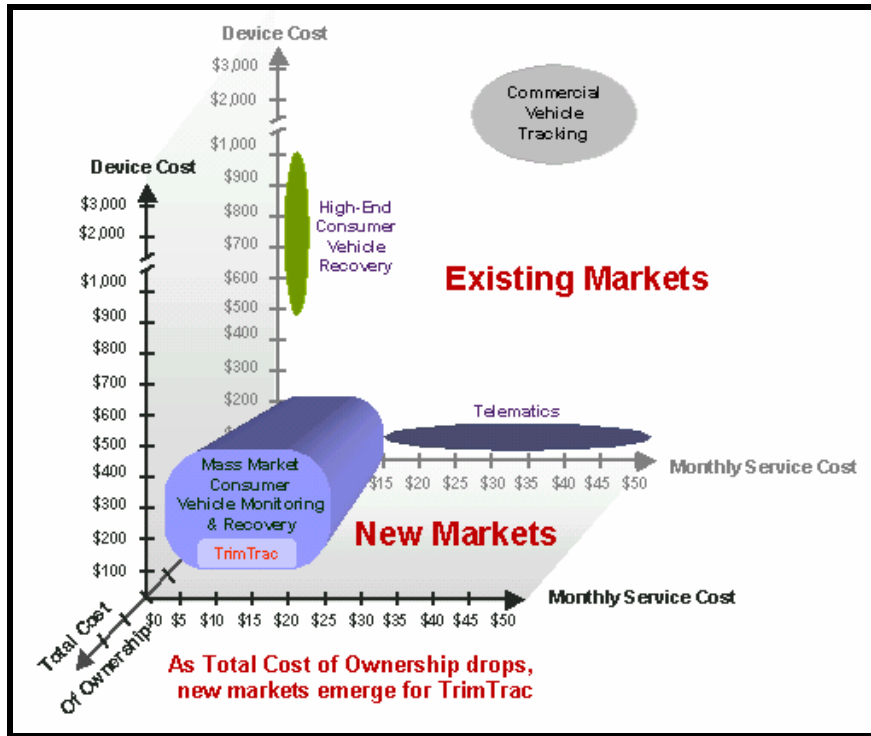


Figure 1: The TrimTrac locator costs significantly less than alternative devices

Functional Overview

The TrimTrac locator is an affordable, fully integrated asset tagging and monitoring device suitable for any application requiring periodic autonomous position reporting and cost-effective wireless communication. It combines worldwide GSM communications with GPS location technology to provide periodic location and status reports. The TrimTrac locator supports target applications by automatically determining and relaying location information. The device is initially targeted for consumer automotive monitoring and recovery applications and services.

The TrimTrac locator is self-contained in a durable, water-resistant housing, and provides indoor and outdoor position reports. Its enhanced GPS sensitivity mode allows it to operate in environments in which traditional GPS devices do not work.

In a typical application with good GPS signal strength, the TrimTrac locator operates for up to 90 days on a single set of four AA batteries. No other connection to an external power supply, antenna or other devices is required. For permanent vehicle installations, it can be connected to vehicle power with an optional Vehicle Adapter Module. The Vehicle Adapter Module also contains a rechargeable stand-by battery that allows the TrimTrac locator to continue operating if vehicle power is disconnected.

The TrimTrac locator's dimensions are 5.25" x 2.5" x 1". The device weighs 3.6 ounces without batteries or optional modules. Its position is typically accurate within 20 feet horizontally and 35 feet vertically. It can get its location position ("fix") in less than 90 seconds from a cold start and 14 seconds from a hot start (standard GPS), or somewhat longer for enhanced GPS (when faced with weaker signals). The TrimTrac locator is activated by installing a SMS-enabled SIM (Subscriber Identifier Module) card from a wireless carrier, and four AA batteries.

The device operates by periodically sending position reports when a vehicle is in motion, and can also be instructed by an application to report position when a vehicle is stationary. The TrimTrac locator obtains a location fix and reports it via a GSM SMS message. Upon receipt of the message, the device can be queried by an application. The TrimTrac locator can, for example, report more frequently or change any of its configurable parameters to meet application or end-user requirements.

The TrimTrac locator by itself is part of a complete solution. To be operational, it requires a wireless carrier and a call center or end-user application (see Figure 2). The customer interacts with the application, such as vehicle monitoring over the Internet. To this end, Trimble is working with third parties who utilize the TrimTrac locator to enable their systems and services.

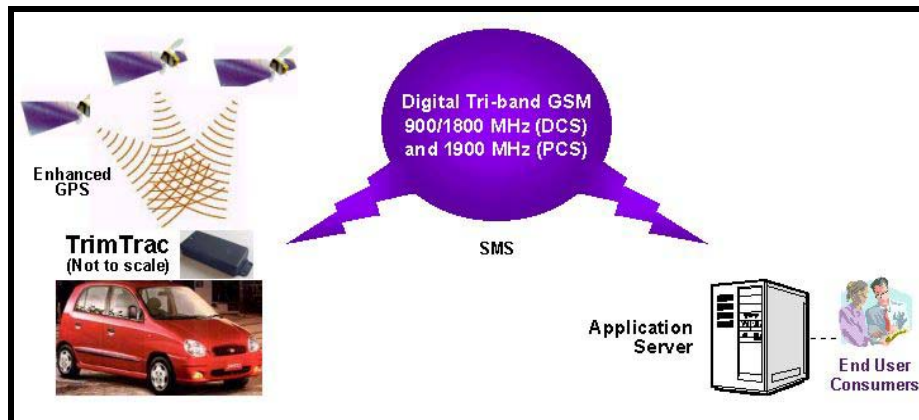


Figure 2: The TrimTrac locator is part of an overall solution that includes GSM communications and an application server.

The TrimTrac locator uses SMS messages sent over GSM networks to communicate with the application. SMS is a store-and-forward data messaging system, similar to e-mail, as opposed to "live," real-time instant messaging. The application may not immediately receive position reports from the TrimTrac locator because there could be a delay as the SMS message is first routed through the network's SMSC (Short Message Service Center). In practice, the latency induced by this message routing scheme is negligible; however, network operators do not guarantee delivery of SMS messages either within or across networks.

SMS Versus Other Communications Standards

An important design consideration for the TrimTrac locator was whether it should use SMS, as opposed to another wireless communication standard such as GPRS (General Packet Radio Service). The TrimTrac locator is intended for use in applications that require the periodic transmission of relatively small amounts of data, with an emphasis on low power consumption by the device. GPRS is better suited for applications that involve real-time, two-way communication and the transfer of larger amounts of data as might be required by an application such as high-end commercial fleet management. GPRS has disadvantages relative to SMS for the uses for which the TrimTrac locator is intended. Specifically, GPRS would create a bigger drain on the TrimTrac locator's power, increase the cost of the device and provide a coverage area that is more limited than that provided by SMS.

Vehicle Monitoring and Recovery Applications

Studies indicate that private automobiles are typically used two hours each workday. During this time, drivers are engaged in activities such as commuting, shopping, and running errands. The vehicle is often stationary the rest of the day.

The TrimTrac locator has been developed, in part, with this usage profile in mind. To minimize communication costs and power consumption, the TrimTrac locator constantly monitors vehicle motion and only provides updated location reports while the vehicle is moving. It does not, for instance, repeatedly report location to the application if the vehicle has not moved since the last position report, unless otherwise specified by the server application.

While the vehicle is in motion, the device will report location at an interval specified by the application. The default is set at a 15-minute report frequency while the vehicle is in motion, which equates to approximately ten location reports per day, assuming two hours of daily vehicle usage.

In its default configuration, the TrimTrac locator will determine location before sending a location report after a vehicle first begins to move; however, in certain security-oriented applications, the end user may wish to be alerted as a vehicle starts moving rather than waiting for a new location report. In these situations, an application server can instruct the device to report movement immediately and to follow up shortly thereafter with an updated position report. It is the role of the application to distinguish between expected and unexpected movement.

The TrimTrac locator also supports other popular vehicle monitoring applications including track logging, geo-fencing, and excessive speed reports.

Track Logging. The TrimTrac locator enables two types of track logging: application-based and device-based. In application logging, the user stores and accesses historical location and status reports directly from the application server. In device logging, the TrimTrac locator determines location and attempts to report this information at the specified reporting frequency. There will be times when there will be insufficient communications to send reports to the application. The device maintains a log of up to 128 of the most recent reports and can, upon



request by the application, communicate previously unsent reports once connection to a network is re-established.

Geo-Fencing. In geo-fencing, the user instructs the application to establish geographic regions in which the vehicle is either expected or not expected to operate. The application compares the TrimTrac locator's reported location to expected areas and acts upon any exceptions.

Speed Monitoring. The TrimTrac locator's location reports include velocity. If the reported speed exceeds the threshold set by the user, the application can immediately request an additional position report to confirm the speed, and once verified, send an excessive speed message to the user.

The server application determines how and when the latest location and status information is presented to the end user. In this system-level architecture, the device is a "sensor" that determines and reports location. The TrimTrac locator operates in accordance with its default configuration parameters or those set by the application. It is the application that determines the frequency at which the device sends updated position information. The application can dynamically change the update rate when it communicates with the TrimTrac locator.

For instance, the application can configure the device in "normal mode" to report location every 15 minutes while the TrimTrac locator is in motion. If the device is not in motion, there is no need to continuously report position. When the user expects the vehicle to remain stationary, he can instruct the application to "arm" the TrimTrac locator so that any movement would cause the device to immediately send a motion report to the application. The application can notify the user and increase the TrimTrac locator's reporting frequency, perhaps if and when the user confirms that the movement is unauthorized.

In other usage scenarios, it may be useful for the user to poll the device to determine its current position. In response, the application can immediately report the unit's last reported position and then provide updates when the TrimTrac locator is in motion. The application and not the device enables this "polling" capability. Should the application require more frequent position updates, the application can increase the reporting frequency whenever the TrimTrac locator communicates with the application.

The TrimTrac Locator's Value

The TrimTrac locator's value is understood by considering its unique set of capabilities and attributes:

- Autonomous, accurate position determination — the device determines its position using enhanced GPS. This allows it to be accurate within approximately 20 feet horizontally and 35 feet vertically. It is also able to get a position fix in many environments where traditional GPS cannot. It does not require other hardware (such as RFID) or signals (such as proximity to cell towers) to determine its location.
- Wireless Communication — the TrimTrac locator leverages near-ubiquitous GSM wireless networks to report its position. This makes the device most appropriate for use in major

metropolitan areas and along interstate corridors. The TrimTrac locator is not well suited for applications that involve extensive use in rural or low-population density areas, or for indoor-intensive situations where it is difficult to achieve a cell signal.

- Motion-Based Position Reporting — The unit only reports position when motion has occurred. This minimizes power consumption and communication costs, and makes the device well suited for the monitoring of mobile assets such as vehicles.
- End User Packaging — By integrating all of its components, along with power and antennas, into one package, the TrimTrac locator is very easy-to-use and eliminates expensive and hassle-prone installation.
- Power Conservation — The unit is designed to run for up to three months on four AA batteries, assuming good signal strength and up to ten position reports per day.
- Permanent vehicle installation is supported by a Vehicle Adapter Module that:
 - Enables more frequent position updates and polling than what is possible with internal batteries alone
 - Eliminates the periodic changing of batteries (e.g. for covert use)
 - Extends temperature and vibration specifications beyond what is possible with internal batteries
- Low cost — By integrating all functions on a single board controlled by a common microprocessor, the device costs far less than alternative devices. SMS messaging reduces ongoing communication costs.
- The TrimTrac locator is produced by a manufacturer with high-volume manufacturing capabilities and quality processes, resulting in high product reliability.

These capabilities and attributes make the device ideally suited for vehicle monitoring and recovery applications because its:

- low cost opens up a new segment of the market.
- use of GSM permits vehicle reports in high density urban areas and along interstate corridors, and its enhanced GPS sensitivity enables position determination in many environments in which traditional GPS does not work
- motion-based reporting reduces power usage and communication costs
- end-user packaging makes it easy to install and use
- power conservation and the Vehicle Adapter Module extend operating life



Future Directions

The TrimTrac locator is the first in a series of innovative, multi-function asset tracking solutions from Trimble. The product family combines the latest in location and communication technologies and leverages industry standard hardware and software for easy and rapid adoption. It deeply integrates location and communication technologies for cost savings and power conservation. Over time, Trimble and its partners will offer the device plug-in modules that support new and emerging communication standards and positioning technologies.

For More Information

Please contact your Trimble Components Technologies Sales Representative or visit www.trimtrac.com.

The TrimTrac Locator Features and Benefits

Complete packaged end user device — Easy-to-use; expensive installation eliminated

No external connections or antennas — Easy-to-use; lower cost

Tri-band GSM 900/1800 MHz (DCS) and 1900 MHz (PCS) — Provides a wide coverage area. GSM is the dominant wireless standard worldwide, especially in Europe and most of Asia. In the United States, it works in all major metropolitan regions and along interstate corridors. T-Mobile, AT&T Wireless, Cingular, and others use GSM as their primary supported digital wireless standard in the United States. Thus, the device can operate wherever these carrier's signals are available.

Short Message Service (SMS) — SMS is available on all GSM networks worldwide (unlike GPRS). It is an efficient, cost-effective, and secure way to transmit the limited data that is sent and received by individual the TrimTrac locators.

Indoor and Outdoor Position Reports — Unlike traditional GPS devices that only operate outdoors, the device uses enhanced GPS sensitivity to independently send location information in a wide variety of indoor settings or similar environments that do not necessarily have a clear view of the sky.

Battery Powered or Connect to Vehicle Power — Battery power enables the TrimTrac locator to be instantly used without installation, as well as deployed in a wide variety of situations where external power is unavailable. Furthermore, the device is appropriate for vehicle monitoring and recovery applications because the optional Vehicle Adapter Module features a rechargeable stand-by battery that enables the TrimTrac locator to continue operating even if vehicle power is lost. The stand-by battery automatically recharges once vehicle power is restored.

90-Day Operation on four AA Batteries — This power life represents a major advance in power conservation, ease-of-use, ease-of-maintenance and cost of operation. Please note that battery life will decrease if the device is used in environments with low GPS signal strength.