

# CARGO AND VEHICLE TRACKING

June 2005

**Cargo and vehicle tracking** is the ability to trace goods, their containers, and their conveyances from the point of origin to their destination. Tracking is increasingly associated with information transfer using smarter tools such as radio frequency identification devices and global positioning systems.

## The Needs of Today's Supply Chain

Recent developments in the realm of international trade have increased the need for heightened security to prevent multi-frontal attacks. The dual missions of protecting national security and collecting duties and taxes drive governments' interest in maintaining the integrity of the supply chain. The interest of private companies in just-in-time, reliable delivery, cost-effective logistics, and maintaining the integrity of goods leads to the development of many tracking systems.

Often overlooked as a supply chain vulnerability is the movement of goods from the manufacturer to the port or border crossing, or from the port to the distribution center. Tracking represents an additional layer of security to ensure goods reach their destination in the same condition as they began their journey, though other layers must be put in place to achieve a more comprehensive level of safety for vehicle and cargo transit.

Lost or resting cargo containers and vehicles represent the point in the supply chain at which goods and conveyances are most vulnerable. Some studies have indicated that 70 percent of senior executives are not satisfied with their ability to track their moving assets to ensure integrity and safety. Tracking cargo and vehicles allows for advanced processing of information by border and intelligence agencies and assists in defeating the vulnerabilities associated with inland drayage, the most vulner-

able aspect of the supply chain. To adequately provide security, the cargo and vehicle must be able to be tracked independently, but the tracking mechanism needs the capability to associate the two data points.

## RFID Technology

Radio frequency identification devices (RFID) are low-cost tags that assist in the tracking of goods and vehicles. These devices are placed on individual items and can either be active, i.e., constantly emitting a radio frequency signal; or passive, i.e., only emitting a signal when queried by an outside source.

In order to track goods, readers (either hand-held or fixed) need to be installed to track and record the numbers from the RFID devices affixed to each product or container. Installation of these readers, however, adds additional costs which would be assumed by the shipper or passed along to the consumer/end user.

RFID tags are limited in the number that can be screened by each reader at one time. For large numbers of loose goods, individually tagging each good is not an efficient use of resources. Tagging the unit containing these loose goods is a more practical solution. RFID tags may not be practical for all applications, including tracking liquids and items wrapped in metal or foil, as these environments can create interference.

The RFID tags only serve as a tracking



Benefits of Cargo and Vehicle Tracking	
Public Sector	Private Sector
Increases security by providing information on the movement of cargo throughout the international trade environment.	Port authorities and terminal operators are more capable of knowing the inventory and location of all items in the yard at all times.
Assists with the customs clearance process.	Maintains the integrity of goods and the supply chain.
Can help reduce the risk of terrorist attack by hijacking a container or vehicle.	Serves as a deterrent against theft and pilferage, thereby reducing costs.
Improves the ability to monitor the flow of goods to and from ports.	Provides efficiency throughout the transport process.
Creates a more efficient system that saves time and money, while improving the quality of cargo and vehicle screening.	Improves communication directly with customers and enables more exact time estimates.
Use of initially voluntary standards allows business and government to forge a relationship of mutual benefit through maximizing efficiency and security of borders.	

mechanism; they do not possess any effective security applications. To work properly, specific frequencies will need to be designated for RFID use only. Government assistance and cooperation is needed in order to prevent interference with other existing devices and applications.

While RFID development is progressing rapidly, three issues could limit its spread in the near future. First, there is an ongoing intellectual property dispute regarding parts of the specifications related to commercializing the electronic product code (EPC) technology. Second, EPCGlobal, the nonprofit organization charged with commercializing the EPC technology, and the International Standardization Organization (ISO) differ on the specification dealing with the numbering systems to which RFID tags relate. Finally, many of the products being sold are not fully upgradeable to the next generation of RFID technology that will be released shortly.

### Authentication/Legitimization of Customs Procedures

Tracking can help verify the identity and contents of a vehicle or cargo container, and its use—coupled with risk management techniques—makes some of the current customs procedures redundant. Elimination of those redundant procedures would expedite the customs examination process and increase the assurance that the vehicle or cargo container is safe and originates from an authorized or legitimate shipper.

RFID uses radio waves to automatically identify an object, often by storing a serial number (and any additional information up to 2 MB) on an antenna. A receiver emits a short-range alert when the integrity of the bulk has been compromised. Some RFID tags also monitor environmental conditions.

Tracking automates the customs clearance system, thus minimizing the opportunity for corruption through bribery of customs personnel. Barcode scanning simplifies the tracking process by identi-

fying the cargo and conveyance through an individual code and a fixed reader and transmitting that information to a central point.

### Benefits of Cargo and Vehicle Tracking Satellite Systems and GPS

Global Positioning System (GPS) tracking utilizes satellites to monitor fleets of vehicles or cargo containers, thereby ensuring there are no unplanned stops and that a preplanned route is followed. Geostationary Earth Orbit (GEO) satellite systems use satellites that orbit the earth at the same speed of the earth's rotation, in order to continuously monitor a particular area continuously.

These satellite mapping areas can be as large as North America or Australia, yet can identify individual containers and vehicles. Networks of multiple satellites that sweep the globe and monitor activity all over the world comprise Low Earth Orbit (LEO) systems. This category includes voice-capable “big LEO’s” and lower cost, data-only systems dubbed “little LEO’s.” Satellite systems are only viable options for tracking when the transmitter located on the vehicle or cargo has a direct line of sight to the satellite. They are consequently impractical when utilized on double-stacked railcars, in the holds of vessels, and in the stacks at container yards.

Despite some benefits of satellite tracking, the GPS signals emitted from most transmitters used by private industry and most federal governments are not secure and are easily counterfeited. Thus, they create problems for precise tracking. A false GPS signal can be replicated and transmitted to the receiver, masking the true location of the cargo or vehicle, which allows for theft of cargo or the introduction of an undesired element into a container or vehicle.

For more information, visit:

<http://www.eyefortransport.com/index.asp?news=38732&nli=freight&ch>

## Examples of Current Tracking Programs

All of the following programs establish international and national codes of conduct which hold non-compliant companies and countries increasingly accountable for their actions through the creation of appropriate and enforceable sanctions.

- ◆ Smart and Secure Trade Lanes (SST) integrate business advantages with security requirements. Containers with Smart Tags bypass many customs delays by transmitting their information automatically, while simultaneously transmitting vital information about their load via an RFID transmitter. The US has expanded this project through the Container Security Initiative (CSI) to the top 34 with which it interacts, involving almost 80 percent of the cargo shipped to the US.

- ◆ The Advance Cargo Information System (ACIS), developed by the United Nations Conference on Trade and Development (UNCTAD), allows cargo and transport equipment to be tracked through ports and railway systems. Cargo can be tracked while on rail, at ports, and on lakes and rivers. ACIS primarily consists of a set of computer applications and agreements between beneficiary organizations for maintenance. ACIS has been implemented in several countries throughout the world, including Thailand, Kenya, Tanzania, and Bangladesh. In these countries and others, the program has successfully tracked containers from the point of loading to the final destination, as well as reduced the time that containers spend sitting idle.

For more information, visit:

<http://www.unctad.org/Templates/Page.asp?intItemID=1979&lang=1>

- ◆ Other US programs that help to track and streamline the movement of goods into that country include the Automated Commercial Environment (ACE) and FAST.

For more information, visit [US Customs & Border Protection's website](#).

- ◆ A cross-border, bilateral agreement on rail security exists between Germany and Poland. They exchange information on security incidents and risks. Additionally, both countries share the burden of patrolling borders.

- ◆ International standards harmonize regulations thereby simplifying processes for companies and governments. The International Ship and Port Facility Security (ISPS) Code represents one attempt towards establishing such standards in maritime transport.

For more information, visit:

<http://www.imo.org/home.asp> (click on ISPS Code Database)

- ◆ Chinese government officials, terminal operators, and businessmen have recognized the efficiencies associated with tracking cargo, including faster clearance of goods, automated data interfaces, and the development of new technologies. Through supportive government policies, rapid telecommunications growth, the development of location-based services, and supportive infrastructure, such as the development of digital maps of highways and cities, cargo and vehicle tracking operations are expanding rapidly and can be used for fleet management applications and advanced traveler information. For example, a Universal Land Transport Management System, developed by Exel, through GPS and advanced wireless technologies, is designed to track vehicles on delivery routes, provide real-time transmission of delivery milestones, and allocate freight according to any number of different user-defined details. China's government is highly supportive of such developments and projects.

For more information, visit:

<http://www.eyefortransport.com/index.asp?news=42070&nli=freight&ch=>

## Costs of Tracking

The ultimate costs of effective cargo and vehicle tracking, as well as the party that will ultimately bear those costs, is still to be determined. RFID tags currently cost between a few US cents and one US dollar. The cost per tag is expected to drop

## Case Study: Wal-Mart and RFID

Beginning in January 2005, Wal-Mart is requiring that its top 100 suppliers encode all pallets and cases with RFID tags that can be scanned by readers located at distribution centers. These tags must be located on all items sent to the distribution centers and readable 100 percent of the time.

Wal-Mart has issued this mandate as a cost-saving and inventory control measure. By obtaining a more accurate accounting of goods in the distribution centers, the retail chain can more accurately move goods based on demand. By January 2006, Wal-Mart plans to impose this requirement on its top 200 suppliers. The impact this program will have on Wal-Mart and its suppliers remains to be seen, including who will bear the additional costs associated with implementation.

Following Wal-Mart's announcement, other companies, such as Albertson's Inc. and Best Buy Co. Inc., have begun pursuing similar RFID initiatives.

### Case Study: SST for Africa

In March 2004, the U.S. Trade and Development Agency, the South African Port Operations, the Namibian Port Authorities, the World Customs Organization, and Savi Technologies initiated the “Smart and Secure Trade Lanes” for Africa project, designed to establish a global model for secure trade within Africa and from Africa to other countries. The project will examine three trade lanes from South Africa and Namibia to the United Kingdom and the United States and will include both sea and land routes. Smart RFID security sensor tags are affixed to each container, which communicate the location and security status of each container to fixed and handheld readers throughout the supply chain.

The pilot project will be completed in January 2005 and will have involved 50 smart container shipments. Upon completion, the results of the project will be evaluated and further steps will be determined by all those involved.

For more information, visit [Frontline Solutions](http://www.usda.gov/trade/FrontlineSolutions)

Or: [http://www.usda.gov/trade/press/Feb10\\_04A.html](http://www.usda.gov/trade/press/Feb10_04A.html)

as more companies and governments mandate their use and production increases. The use of RFID technology also necessitates the purchase and utilization of either fixed or handheld readers to be installed at the points of origin and departure. Costs associated with this type of equipment are significantly higher.

GPS technologies are comparatively more expensive on a per item basis, but fewer devices would be needed per container. The cost could be approximately \$50 per month per vehicle, plus additional upfront costs for the hardware necessary for GPS tracking. To accurately provide location and tracking information, a vehicle would need a transmitter installed and the ability to communicate with a satellite. Additionally, a data dissemination facility is needed and serves as a critical component for receiving, processing, and distributing the data transmitted by the satellite.

### Conclusion

Cargo and vehicle tracking has increased in use over the past few years and, based on current trends, this rise should continue. Tracking offers benefits to both private and public sector individuals, allowing for real-time visibility of goods and the ability to receive advanced information regarding cargo and security status. The primary means of tracking cargo and vehicles, through RFID and GPS technologies, are quite common yet still require further development to truly provide accurate and secure information with regard to the location and status of vehicles and cargo.

The private sector will be primarily responsible for leading the development

and enhancement of technologies which further expand current cargo and vehicle tracking capabilities. Governments throughout the world can play a role by providing incentives to companies developing tracking alternatives, or mandating the use of certain technologies on all cargo/container shipments and commercial vehicle travel to or within their country.

The ongoing pilot projects described above should demonstrate the viability of the tracking technologies and the cost-savings that can accrue through their use. As they progress, more quantifiable information will be available, allowing for countries and companies to make more informed decisions regarding cargo and vehicle tracking and the associated technologies.

### Additional Resources and Links

- ◆ A New Team Against Terrorism, [www.cbp.gov/xp/CustomsToday/2003/june\\_july/ntcfinal.xml](http://www.cbp.gov/xp/CustomsToday/2003/june_july/ntcfinal.xml)
- ◆ Smart Tags Bring Security to Containers Entering US, [http://bulktransporter.com/mag/transportation\\_smart\\_tags\\_bring/index.html](http://bulktransporter.com/mag/transportation_smart_tags_bring/index.html)
- ◆ Strategic Council on Security Technology, <http://www.scst.info/>
- ◆ WCO Security and Facilitation Initiatives, [Container Security](http://www.wco-woit.org/containersecurity/)
- ◆ South African Society for Intelligent Transport Systems – Vehicle Tracking, [http://www.sasits.com/index.php?page\\_id=452&id=41](http://www.sasits.com/index.php?page_id=452&id=41)
- ◆ Report on Container Transport Security Across Modes: Executive Summary and Conclusions, <http://www.oecd.org/dataoecd/29/8/31839546.pdf>
- ◆ RFID and Homeland Security, <http://www.aimglobal.org/technologies/rfid/resources/articles/dec03/Homeland.htm>

This GFP Note has been produced with the financial assistance of a grant from TRISP, a partnership between the UK Department for International Development and the World Bank for learning and sharing of knowledge in the fields of transport and rural infrastructure services. This Note was prepared by JBC International and reviewed by the World Bank Trade Logistics Group and GFP Steering Committee. The preparation of the GFP Notes was coordinated by Gérald Ollivier, World Bank. The views published are those of the authors and should not be attributed to the World Bank or any other GFP affiliated organization. Additionally, the conclusions do not represent official policy of the World Bank, its Executive Directors, or the countries they represent. For more information, contact Mr. Ollivier at [golliver@worldbank.org](mailto:golliver@worldbank.org).