RFID IN PORTS AND TERMINALS

A PEMA INFORMATION PAPER

This Information Paper is intended to provide a high level overview of the use of Radio Frequency Identification (RFID) in the ports and terminal sectors.

The document describes how RFID technology works and discusses its applications in the global port and terminal market. Past, current and future adoption trends are reviewed, together with benefits and expected ROI from the use of RFID.

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INTRODUCTION

DOCUMENT PURPOSE

This Information Paper is intended to provide a high level overview of the use of Radio Frequency Identification (RFID) in the ports and terminal sectors. The document describes how RFID technology works and discusses its applications in the global port and terminal market. Past, current and future adoption trends are reviewed, together with benefits and expected ROI from the use of RFID.

DEFINITIONS AND TERMINOLOGY

Like any industry, some understanding of the language of RFID is required. There is a broad set of terminology used to describe technologies, applications and processes in relation to the ports sector and for RFID itself. A full lexicon is provided in Appendix 1.

The 'port' designation used throughout this paper is a simplified one, as the extent of the market transcends maritime areas to include inland intermodal rail and road haulage etc.

For the purposes of this document, 'ports' include port authorities, port communities, shippers and beneficial cargo owners (BCOs), marine terminal operators (MTOs) and inland terminal operators (ITOs). The scope covers containerised cargo, general cargo, ro-ro and bulk operations, regardless of geography.

ABOUT THIS DOCUMENT

This document is one of a series of Information Papers developed by the Technology Committee (TC) of the Port Equipment Manufacturers Association (PEMA). The series is designed to inform those involved in port and terminal operations about the design and application of software, hardware, systems and other advanced technologies to help increase operational efficiency, improve safety and security, and drive environmental conservancy.

This document does not constitute professional advice, nor is it an exhaustive summary of the information available on the subject matter to which it refers.

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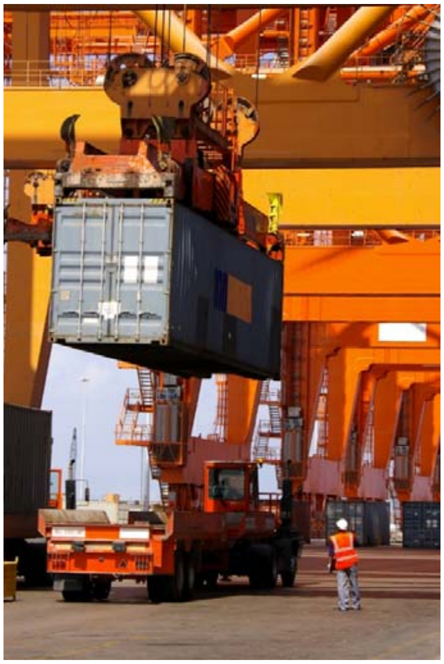

1 | EXECUTIVE SUMMARY

Radio Frequency Identification, or as it is more commonly known, RFID, is an automated identification and data collection (AIDC) technology. From access cards to passports to toll tags RFID has now become ubiquitous as an integral part of our daily lives.

The basic concept is simple. An object to be tracked is identified with a transponder or 'tag'. Periodically, the tag unilaterally 'beacons' its unique ID number or is requested to broadcast these data by an RFID reader. The reader captures tag data and passes these to middleware, which filters, aggregates and formats the data for presentation to a business application. Various types of RFID technology exist but the most common are passive (no battery) and active (with battery).

RFID is widely used for the identification and tracking of people, assets and inventory. The core benefits are that it provides identification without requiring line of sight, can be read at short to very long range and can be encoded with significant amounts of data. These attributes distinguish it from other AIDC technologies.

Historically, the ports market was an early adopter of RFID and today represents a proven, growing field for this technology.

However, what started as a market focused on the use of passive RFID for security purposes has since evolved to a predominantly active RFID market for long range asset tracking and process automation, including:

Network asset visibility: tracking assets such as trucks and containers across multiple supply chain nodes

Operational control: providing visibility and process automation within the port or terminal

Safety: ensuring the safety of personnel and equipment, typically within a facility environment

Security: providing access control and securing assets and inventory

Today, the overall RFID market in ports is worth nearly $100m per year. The largest segment of this is within port community and marine container terminals for automating gate and yard processes. Going forwards, the emergence of new applications using RFID as a "wireless sensor" integrated with telemetrics may change the way the market develops.

The application of RFID has so far been driven by typical 'industry standard' benefits, including labour productivity, safety and security and increased asset utilisation. However, a key additional driver of growth in the port community and MTO market today is environmental.

Ports and marine terminals are highly visible and often located in or close to large populous areas. Their impact on the health of the surrounding communities and contribution to greenhouse gas (GHG) emissions have come under increased public scrutiny in recent years, particularly with regard to emissions from over-the-road diesel trucks, but also for internal vehicles.

As ports seek to respond to these challenges, RFID has become an integral part of vehicle tracking initiatives tied to clean air emissions reduction programmes, as well as helping optimise travel of internal vehicles.

2 | BACKGROUND

2.1 WHY RFID?

RFID is one of many Automated Identification and Data Collection (AIDC) technologies available for tracking assets and automating processes within the port and terminal environment. Other technologies such as barcode, GPS and optics (laser, OCR) are also proven and provide similar functions in many applications. So why RFID and why is it especially applicable in the ports area?

RFID is unique in that it enables the automated 'hands free' identification and locating of 'things'. In the context of the ports market, these are usually assets – including people, inventory and equipment.

Historically, the most recognised application is the use of low frequency RFID for security access cards. While this application is now well-established, indeed pervasive, perhaps the greatest advantages of RFID lie in the longer read distances and large number of assets that this technology is able to identify and locate at the same time.

For example, OCR for vehicle license plate recognition requires direct line of sight to a truck and must occur within a short range. An RFID tag on a container or truck can be read from almost a kilometer in some cases. Staying with the gate example, OCR must read each plate one at a time. An RFID reader can simultaneously read hundreds of tags in the gate area.

To be clear however, each AIDC technology has its advantages and disadvantages. OCR for example will read any truck with a license plate essentially for the cost of the license plate, OCR camera and software. In the case of RFID, each truck will require a tag which, based on the technology selected, may be more costly.

In advanced RFID systems, concepts of location and ID are being further expanded. Telemetric sensors are being integrated with RFID tags to create wireless sensors able to report multiple conditions and status on a near real-time basis.

RFID systems growth in the ports and terminal market has risen from the vortex of four parallel forces:

2.1.1 WIDESPREAD DEPLOYMENT

Where RFID in the past may have been a boutique technology, it is now all but ubiquitous in our daily lives. RFID access cards, passports, toll passes and other things we touch every day all use RFID. This widespread use has helped foster a higher level of recognition and acceptance of RFID in the ports market.

2.1.2 GROWTH IN AUTOMATION

As noted above, passive and active RFID technologies allow for highly efficient and/or hands-free asset identification and tracking. As more companies recognise the need to have improved visibility to, and control of, assets as well as automate processes, RFID usage is increasing one of the lowest cost means of achieving these goals.

2.1.3 ADVANCES IN TECHNOLOGY

Along with greater acceptance, the technology itself is getting better. Tag and reader capabilities have been enhanced, making better, longer distance reads possible. This also includes the integration of telemetric sensors with RFID tags. Parallel advances in RFID production technology and better packaging of the tags themselves have also taken place, reducing tag costs. Taken altogether this is enabling more justifiable, widespread deployment of RFID systems.

2.1.4 ADVANCED DATA INFRASTRUCTURE

All of these issues are underpinned by the ease of distributed data capture and processing through the use of advanced communications infrastructure such as wireless LANs, virtual private networks (VPNs) and the Internet. These advances bring the real-time capture of asset data and transmission to a point hereto unachievable.

Early RFID applications were confined to simple closed loop systems, where the RFID data could be securely and cost-effectively transmitted back to the business application. Today, more widespread communications infrastructure allows RFID data to be collected and transmitted much more cost-effectively across wider areas, opening up a whole host of viable new applications for port community and terminal systems.

2.2 HISTORY OF RFID IN PORTS

Active, passive and semi-passive systems have all been deployed on a global basis for over 15 years in the ports market. Geographically, a large percentage of RFID implementations have been on the West Coast of the USA and in northern Europe.

Historically, and into today, ports have been primarily a market for active RFID based solutions. Several application areas such as security (driver identification) and some gate applications are passive. However, the preponderance of installations to date is active.

The reasons for this are twofold. Firstly, active tags provide the longer read ranges needed in most visibility and process automation applications. Secondly, they allow for a greater 'leverage' effect. Leverage implies that based on the versatility of active technology, more than one application can use the underlying reader infrastructure. For example, tags on trucks at the gate, reefer units in the yard and terminal tractors at the quayside can all be read with the same reader network

As noted earlier, the first RFID deployments were for gate access and security. These were and remain low frequency (125KHz) passive systems. Most users recognise the need for personnel identification for access to a terminal but also for equipment use validation. Today, government mandated cards like TWIC, MSIC and ISPS all use RFID.

By the mid 1990s, many systems were deployed using RTLS (real time locating system) technology to locate assets on the yard of container terminals, especially on the West Coast of the USA. By the early 2000s, the need for RFID tracking in conjunction with port community systems emerged. The PierPass program in Los Angeles/Long Beach is the largest example. This was followed by deployments in South Africa, Finland, Georgia USA, Dubai UAE, and elsewhere.

In addition, this period saw large scale RFID visibility projects for container logistics deployed by the US military and shipping lines including APL, Matson and Horizon Lines. Several experiments with electronic seals, or e-seals, were also undertaken.

By the mid to late 2000s, the technology had developed to automate more processes inside the yard such as automated job stepping/promotion, container handoff and quay crane automation.

2.3 CURRENT MARKET

The current market is vibrant and has been steadily growing, excluding the 2008-10 economic downturn. Most of the large scale deployments remain concentrated in the marine container terminal and port community areas, focused on applications for gate and yard automation.

New opportunities also exist across a broad number of additional submarkets and applications. For example, the use of RFID for wireless reefer monitoring is now available. RFID is also being combined with GPS for cargo tracking and security and a whole new range of applications in bulk container handling are emerging.

2.4 LOOKING AHEAD

So, where will RFID go? Several trends are emerging.

2.4.1 MORE TELEMETRIC SENSORS

Users should be looking at the continued growth of RFID as a ‘wireless sensor’. RFID transponders can capture data on security tamper signals (e-seals), temperature, motion, speed, light etc. The wireless nature of RFID and its lower cost compared to PC or PLC based processors to capture this data make it an attractive AIDC option.

2.4.2 CONVERGENCE

The convergence of advanced technologies has led to the emergence of new applications.GPS chip sets are now integrated with RFID tags to create a hybrid technology set. This has resulted in low cost, precise locating but with the further advantage of minimal impact on data networks. The data can be wirelessly backhauled through the existing RFID reader network.

2.4.3 MULTI-USE INFRASTRUCTURE

The bulk of RFID systems today are single purpose. However, once the RFID reader infrastructure is installed, other applications may feed off the same reader network, reducing the cost of new deployments. This trend is expected to accelerate.

2.4.4 MORE PASSIVE/SEMI-PASSIVE

While the market has been dominated by active technology, improvements in passive tag read distances are leading users to re-evaluate passive as an alternative to active. The major advantage is the generally lower cost of passive technology, driven by strong standardisation.

2.4.5 MORE STANDARDS

Thus far, the active RFID market in ports can be characterised by a winner take all approach. As virtually all technology is proprietary, if a vendor wins a port community system, for example, the port is committed to that particular supplier until the system is removed.

However, the market is now driving toward more standardisation. The new ISO 18000-7 protocol, commonly known as DASH-7, is the first solid attempt at creating a global standard in the active RFID space akin to Gen2 standard established in UHF passive RFID market.

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3 | TECHNOLOGY

3.1 RFID TECHNOLOGY

RFID systems are basically comprised of four elements:

- RFID tags, also known as transponders
- Readers and related peripherals
- Middleware
- Host and automation applications

RFID **tags** are electronic chips encoded with data and typically encapsulated in a hard casing or applied to a label or similar substrate. RFID tags are placed on the assets to be tracked and monitored. The tag either transmits its encoded data upon request from a reader (hence the term 'transponder') or unilaterally transmits or 'beacons' its data on a fixed periodic basis.

An RFID **reader** receives the tag data and then transmits the tag information to middleware software. The reader will generally transmit the tag ID, reader ID, reader receive time and potentially other telematics data. In some cases, especially with passive systems, the data may be filtered directly on the reader

The **middleware** software assigns a time stamp to the tag/reader information, allows for additional levels of filtering, and may ultimately translate the data into industry standard formats for integration with a host application.

In the case of RTLS systems, the middleware may also include a position engine which determines the tag location through triangulation or other means.

The **host or automation application** software accesses the information from the middleware database to execute its monitoring, management and reporting functions. This may be a TOS, gate automation application, asset tracking application etc.

3.1.1 TAG TYPES, FREQUENCIES, PROTOCOLS, POWER AND 'TECHIE' STUFF

Tag types:

Depending on the asset type and application requirements, RFID tags may be active, passive or semi passive.

Active tags have a battery. They transmit their encoded information either on a fixed periodic basis ('beacon' type) or when polled by a reader and requested to transmit ('response' type). These tags can be read from distances of several hundred metres depending on the tag power, antenna type and surrounding environment. They derive the power to send data from embedded batteries. Because of the battery cost and advanced features, active tags tend to be the most expensive

Above, an RTLS active RFID tag. Below, an active beacon-type tag.
Source: IDENTEC SOLUTIONS

Passive tags derive their power when they are within the field of the reader. The passive reader energises the electronic chip of the tag (termed ‘inductive coupling’) and the tag responds back to the reader. While they are considerably less expensive than active RFID tags, they also have far less read range capability, with most having maximum read ranges of 10m (30ft) or less. In the case of access cards this is often less than one metre.

Semi passive tags have a battery but act like a passive tag, only communicating when excited by a reader. The battery increases the range of the transmission.

The specific application for RFID technology has a direct bearing on the types of tag systems to be deployed and the limitations thereof.

Tag frequency:
Each tag transmits its data at a specified frequency. Active and passive technologies share these frequency ranges. Generally there are four common ranges used in ports today:

Low frequency (LF): This is the 125 KHz range used for access cards (HID, MiFare etc.)

High frequency (HF): This is typically also used for access applications.

Ultra high frequency (UHF): This is generally 433 MHz to 950 MHz. The most common frequencies are 433 MHz for active tags and 868-915 MHz for both passive and active.

Microwave or ultra wide band (UWB): This is the 5.6 GHz range and is exclusively used for active RFID systems.

The choice of frequency is important, in that each frequency has specific data transmission speeds, distances and cost/benefits associated with it. Of note also is that the frequencies are highly regulated by local governments and standards are built around certain ranges.

For example, the 125 KHz LF range is used worldwide and is highly standardised. UHF is standard, but the power permitted for broadcasting is regulated locally.

The net outcome of this for a port is that it must ensure that the proposed technology from a vendor meets national and/or local regulations.

Tag protocol:
The tag protocol is the ‘language’ that the tag speaks to a reader. Historically, most passive systems adhere to specific ISO standards and there is a very open environment, with multiple vendors producing tags, readers etc. which are totally interoperable. In the active sector there are few if any standards. Today, the only open standard with multiple vendors is ISO 18000-7. What this means in the active RFID market is that the vendor selected for a project will be a long term partner and it will be difficult to change supplier technology.

Tag density:
Both active and passive RFID readers have the ability to read multiple tags in an area at the same time. The number of simultaneous treads is termed ‘tag density’.

The concept of tag density is important in that some applications (for instance identifying containers in a yard) must read hundreds of tags nearly at the same time and process all of these reads. Active technology is especially suited to this, as passive systems require each tag to be excited by the reader.

Tag format/application:
Format speaks to the type of housing or label that a tag is placed in or on. **Application** addresses where and how the tag is adhered to an asset. In the ports sector, format and application are very important concepts, as the environment is intrinsically challenging: dirty, wet, cold/hot etc. This contributes to another challenge that both vendor and user must carefully review when initiating an RFID project.

In order to maximise readability, tags often need to be placed on assets (cranes, trucks, mobile handling equipment etc.) in positions that make them more susceptible to damage by other equipment moving round the facility. Because of the differences in cost, and read ranges, great care must be taken and time invested to choose the proper tag given the application.

Advanced telemetric features:
Tags today are not just about location and ID. As noted earlier, tags can integrate with sensors to capture other data. Generally only active tags support telemetrics.

3.1.2 LOCATING CONCEPTS

A key element of RFID is the ability to locate tagged assets. Location can be determined in various ways, the most common of which is zonal (see below). However, real time locating systems (RTLS) based on triangulation and GPS are proven and continue to grow in popularity.

Zonal: In this locating approach, the area to be monitored is divided into zones. An RFID reader is placed in each zone, such that when a tag is seen by a reader, its location is known to be ‘in that zone’.

Resolution for the zones can vary based on the asset being tagged, antenna type and the makeup of the surrounding environment. Typically zones may be 10-500m in diameter. Where needed, more refined resolution can be derived by using low frequency positional markers.

It should be noted that all passive systems use the zonal approach as well as many active systems. It is generally lower cost than other methods and effective enough to know where assets are located.

Triangulation: RTLS systems provide for real-time or near real-time asset tracking using triangulation to determine tag location. They provide more precise locating accuracy (typically <3m) than zonal systems. For triangulation, at least three readers or similar ‘positioning devices’ would be placed in a zone. The tag is heard by, or communicates with, some or all of the positioning devices.

The readers or the tag then send this data to positioning software to determine the location. Using time of flight (ToF) or time distance on arrival (TDoA) calculations to and from the positioning devices, the software can derive a precise location.The application of RTLS in ports is particularly effective and includes:

- Tracking internal vehicle and equipment used to move containers from quay to stack and vice versa
- Tracking of trucks and chassis in a yard
- Locating of operators/personnel

- Locating of hazardous cargo
- Locating of yard inventory such as containers, general cargo, autos, etc.

Once an RTLS network is in place, multiple tagged assets can leverage the same infrastructure.

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Geospatial: With the advent of lower cost GPS chips, some suppliers are now providing a hybrid system for locating. The RFID tag uses a GPS chip to locate itself and then reports its location to a traditional RFID reader. This eliminates the need for positioning device infrastructure. This solution provides cost effective locating for terminal tractors, general cargo, ro-ro operations etc.

3.1.3 STANDARDS

The RFID industry is very involved with, and committed to, international standards. To spur adoption all suppliers have recognised that open technology (think Wi-Fi), total supplier changeability and interoperability are needed. In the passive RFID sector, standards are the norm, with both international standards through ISO and country-level standards in existence. The most well-known today is the ISO 18000-6b standard for UHF tags, commonly referred to as Gen2. This is the type of tag used across most retail applications.

In the active sector, standards have never taken off. Little if any interoperability exists. Some vendors have developed products to a standard but no openness exists, as only one vendor makes the tag.

In the past three years, however, efforts have been made, prompted by the US military, to create an active RFID standard. This is ISO 18000-7. The implications for the ports sector are significant. It means that a tag, like an e-seal, could travel around the world on a container and be read by all supply chain partners using a common frequency and protocol. Moreover, through the efforts of the US military, there are multiple vendors. We should see this standard as well as others develop in the next 3-5 years.

3.2 MIDDLEWARE

Data from RFID reader networks must generally be filtered, aggregated and formatted before presentation to a host system. In addition, the various reader devices must be monitored and managed. Finally, physical device information must be translated to be understood by a host system. For example, reader 123= gate lane 5. This is the role of middleware. Essentially it sits in the ‘middle’ between the enterprise-wide device level (readers) and the host business application

When implementing RFID, most suppliers will offer some form of middleware or SDK (software development kit) to talk to and manage their readers. Alternately, many globally recognised database and operating system providers such as Oracle, BEA and Microsoft provide middleware. Of note is that generally, the middleware does not keep a database of assets or locations. These are defined in the business application.

3.2.1 INTEGRATION WITH TOS AND OTHER HOST SYSTEMS

RFID networks can easily be integrated with terminal operating systems and other host applications. The database of asset and location information will be held at this level and tied to the physical world as a tag record. For example, tag 123 = terminal tractor #5.

Whenever the TOS is informed about a tag event associated with Tag 123, it knows this relates to terminal tractor #5.

3.2.2 INTEGRATION WITH OTHER TECHNOLOGIES

Many allied data collection and automation used in the ports market can also be integrated with RFID:

- Mobile computing aka radio data terminals (RDTs)
- Automated gate systems
- Crane OCR
- Driver identification systems
- Access systems
- Fleet management

3.3 APPLICATIONS

The application of RFID in the ports market falls into four core areas:

Network asset visibility (NAV): These applications support the identification and tracking of assets typically associated with multiple operations or nodes a widespread network. A derivative of visibility, RTLS, also provides precise asset tracking. However, for the purposes of this document we differentiate 'visibility' from RTLS based on the 'nodal' nature of network visibility applications.

This implies that RFID technology used in network asset visibility is intended simply to identify the presence of an asset, while RTLS provides more precise real time tracking and locating.

Operational control: These are applications intended to improve the productivity of operators or automate manual tasks, increase safety or optimise equipment use. They are almost exclusively deployed within a facility.

Safety: Safety applications use RFID to ensure the safety of people as well as hard assets. This is fast becoming a hotspot in RFID as terminal worker safety is increasing in importance.

Security: Security applications use RFID to secure an asset or uniquely identify an individual, generally in conjunction with other security technologies like biometrics.

3.3.1 NETWORK ASSET VISIBILITY

Operators such as BCOs, shipping lines and transport service suppliers manage multiple asset and equipment types across a network of multiple nodes – including terminals, depots, distribution centres, storage yards etc. For these users, visibility and associated control of their valuable transport assets are paramount.

These applications are designated as network asset visibility (NAV) solutions. Examples of NAV applications include:

Over the road (OTR) trucks: OTR truck tracking involves the unique identification and registration of street trucks. Visibility data from RFID-tagged trucks can be used by:

- Visibility across multiple facilities
- Gate operating systems for seamless processing of trucks, including checks for haulage company compliance/permissions
- Clean truck programmes for compliance with port- mandated emissions limits

- Truck cycle time for operator accountability
- TOS crane and stack optimisation based on pre-advised truck-container data
- Port security, bonded cargo tracking, free zone management, etc.

Chassis: The tagging of chassis provides visibility to chassis assets but also supports additional applications:

- Gate operations link chassis to a haulge company at gate checkout and allow for accountability of chassis leasing
- Pool availability based on check-in at a yard
- Utilisation and deployment optimisation of pool or shipping line owned chassis
- Roadability checks

Containers: These are applications where the container itself is tagged and tracked. While several well-known companies have attempted to build container tracking networks, the general ports market does not recognise this as viable, due simply to the fact that there are over 50 million ISO containers in operation today. Many closed loop shippers (mostly Jones Act companies in the USA) have deployed system-wide visibility applications.

Gensets: These are generator sets used to power refrigerated container units when they cannot be directly plugged in, particularly in long-haul US intermodal rail operations.

Slave equipment: Slave equipment includes purpose built pallets, trailers cassettes, etc. used to 'hold' containers or general cargo. In many operations, especially ferry facilities where chassis are not used (due to height), and barge operations where loads are placed on pallets, slave equipment represents a key asset. The general association of the container to the asset is the critical aspect.

3.3.2 OPERATIONAL CONTROL

A key element of port and terminal operations is the ability to increase productivity and/or avoid additional labour costs. RFID applications are increasingly used to improve operational visibility and automate various processes.

In the container terminal market, these processes are further segregated by location: gate, yard, rail and quay.

Visibility data from RFID-tagged street trucks can be used to speed processing through terminal gates
Source: Georgia Ports Authority

Gate operations: In gate operations, the RFID tag on the truck or chassis is first associated with a container, then processed through the gate. This is an increasingly significant application of RFID. Two key points here:

Firstly, due to the lack of interoperability of active RFID, this is a winner take-all and a first mover market. This means that if a vendor wins a key terminal in a port area for the gate, most of the other operators in the same port will use the same tag and, hence, the same supplier.

Secondly, the gate operating or control system market is distinct and separate from RFID. RFID serves as a low cost, more reliable AIDC technology than OCR for truck identification, but is not required in all cases. OCR has been, and continues to be, the preferred technology for the container and optionally the chassis.

Moreover, use of RFID requires tagging programmes be put in place and consensus to be built across multiple stakeholders.

Container transitions or handoffs with container handling equipment (CHEs) in the yard: CHEs typically include terminal tractors, straddles RTGs, RMGs, fork trucks, top picks, side picks, and reach stackers. In this application, the RFID tag uniquely identifies the container through association with the tagged chassis, truck or slave equipment at the gate or at the interface to a CHE. The operator is then presented with the container to handle without typing in an ID or selecting from a list.

Quay crane handoff automation: In this application, a container coming off a vessel is matched to a CHE, either an internal transfer vehicle (ITV) or straddle/shuttle carrier. This requires the ability to uniquely identify both the CHE and the container. Typically, a deck clerk will input the container ID and CHE ID or crane OCR is used. Subsequent transitions will also then be automated. This solution eliminates deck clerks associating containers with ITVs (with OCR) and improves safety.

Reefer monitoring: This application supports the capture and transmission of data from the on-board control units of refrigerated containers. This may be on vessel or more commonly from a dedicated part of the terminal yard where reefer boxes are plugged in and stored

Vehicle tracking/optimisation: In all terminals, large numbers of container handling equipment units (CHEs) are used. Transport CHEs include internal transfer vehicles or ITVs (also called UTRs, bomb carts, prime movers), yard trucks etc. These CHEs are tagged or equipped with RTLS or GPS-based RFID tags and tracked by the TOS or asset tracking application. As the CHE travels, the location is reported to the TOS, which uses this data to:

- Provide visibility leading to better driver accountability
- Select the next best assignment for the vehicle based on its actual location versus a task list

Considering that a medium-sized facility can have 200+ pieces of equipment, this level of control is critical to operational efficiency.

Automated job stepping/container handoff: In the marine terminal environment, task assignment to a CHE or ITV driver is made one-by-one or by job stepping. Operators typically must push a key on an in-cab device when they arrive at the job destination to get the assignment details. It's not uncommon for drivers not to do this, or to do it late, detracting from the efficiency of the TOS. RFID tagging of trucks and ITVs allows automated job stepping by 'knowing' the precise location of a truck and automatically reporting this to the TOS, which will then 'step' the job without human intervention. This minimises labour friction and optimises driver usage.

Truck/chassis tracking: In many operations, especially in the USA, MTOs want to track the location of OTR trucks in their facility and use either permanent or temporary RTLS or GPS tags to achieve this. Similarly, many US operations have staged chassis ready to receive or discharge a box – otherwise known as wheeled operation. To track the location of a chassis, an RTLS is typically used.

Cargo and vehicle tracking: RTLS or GPS tags can also be used to locate inventory in vehicle terminals and general cargo facilities.

3.3.3 SAFETY

The application of RFID for safety purposes addresses several areas:

Personnel tracking: While not common to date in the ports sector, RTLS or GPS tag based solutions can be used to track personnel across a terminal, under the quay crane etc. As personnel safety concerns become more prevalent, RFID is being evaluated as a real solution.

Hazardous control: In many facilities, hazardous materials are segregated and the movement of trucks and personnel must be controlled in this area. RTLS or GPS tagging provides this ability.

3.3.4 SECURITY

The use of RFID for security purposes includes:

Container security: The use of e-seals or container security devices (CSDs) and associated tracking of these devices has been a focus since 9/11. This application has worked only in closed loop systems or supply chains where contents are very high value or sensitive.

Driver and personnel security: Over the road and internal truck drivers must uniquely identify themselves either to enter a terminal or to use a specific piece of equipment. Active and passive RFID 'private' systems have been used, although these are falling out of favour to government mandated solutions.

Asset security: Terminals often have high value items like copper wire which need to be secured. Asset tracking, while not common today, is gaining favour.

An RFID-based Container Security Device
Source: IDENTEC SOLUTIONS

4 | THE MARKET

4.1 OVERVIEW

The port RFID market is broadly defined as that where RFID technologies can be applied to port-related environments. For the purpose of this paper, market size estimates are based on the submarkets discussed below.

4.2 SEGMENTATION

The principal submarkets are as follows:

4.2.1 MARINE TERMINAL OPERATORS

These are facilities which load/unload and process ISO containers from/to container ships. They range from simple mobile crane operations to fully automated terminals. There are approximately 900 terminals globally.

4.2.2 INTERMODAL TERMINAL OPERATORS

These are terminals associated with rail-based container transport networks. In the USA, there are six major rail carriers managing container transport. Globally, rail networks are typically state owned, but intermodal rail services and terminals are increasingly provided by private operators.

4.2.3 BARGE AND FERRY OPERATORS

Coastal and inland waterway operators handling containers through lift on/lift off and ro-ro based operations.

4.2.4 TRANSPORT SERVICES

The haulage companies moving ISO containers between marine terminals, ferry facilities etc and the consignee.

4.2.5 GENERAL CARGO FACILITIES

These are marine terminals where non-containerised goods such as lumber, coal and other bulk products are loaded and unloaded between ship and shore. Cargo tends to be stored in similar fashion to construction yards.

4.2.6 AUTOMOTIVE FACILITIES

Operations dedicated to the temporary storage of cars and other vehicles prior to vessel loading or inland transfer to processing centres (see below).

4.2.7 AUTOMOTIVE PROCESSORS

Port-based third party or OEM-run facilities which prepare vehicles for shipment to dealers inland.

4.2.8 CHASSIS POOLS

In North America, the management of chassis has been increasingly given over to chassis pool managers which do not own the equipment, but oversee the storage and handling of empty chassis. This relieves the shipping lines from managing and maintaining their chassis.

4.2.9 PORT COMMUNITIES

All of the above submarkets are typically associated with a port or hub. Port authorities tend to be government or public sector entities which oversee the management of the entire facility including sea, land and other operations, as well as security.

4.3 MARKET SIZE AND GROWTH

The overall marine segment for RFID is expanding by 12-15% annually with different submarkets experiencing varying growth. The port and MTO segments are estimated to be the highest, enjoying 25% year-on-year growth. In 2011, the total marine market for passive and active RFID is projected to be worth around $100m.

5 | GETTING THE ROI

5.1 NETWORK ASSET VISIBILITY

Users evaluating return on investment for network asset visibility applications are advised to focus on the following areas:

5.1.1 INCREASED ASSET UTILISATION

As noted, real-time management and tracking of marine related assets such as trucks, chassis and gensets improves their availability while reducing downtime in the usage life cycle. Network visibility systems can provide the critical core information to execute advanced decision making on the movement of containers and other transport assets, enabling improved supply chain process management and thereby saving time and/or money. Utilisation is a major cost reduction driver and must therefore be considered a key ROI metric.

5.1.2 IMPROVED CAPITAL DEPLOYMENT

The fundamental issue with assets is cost. Asset purchase and subsequent depreciation has a significant effect on cash flow, the balance sheet and P&L. Protecting this investment and minimising the ongoing need for expenditure is a key ROI element of NAV systems.

5.1.3 ASSET LOSS REDUCTION/PREVENTION

Asset loss reduction has substantial impact on a company's bottom line. For example, asset-heavy operators like ferry companies may experience 10- 40% lost assets. Loss consists of non-locatable assets in the supply chain, i.e. unable to be used, as well as true loss. In either case, new assets must be purchased to refill the available pool.

5.1.4 CONTENT LOSS REDUCTION

"Track the asset and the contents follow". In addition to the asset loss prevention described above, a key benefit of NAV systems is the prevention of content loss. Content loss through theft, mishandling or expiration can be considerable.

For the shipment of high value items such as pharmaceuticals, the use of sealable plastic pallet boxes is common. Minimising the identification of contents (through the use of RFID or barcodes) combined with security devices and effective cycle tracking is paramount.

5.1.5 MAINTENANCE/REPAIR COST REDUCTION

A final benefit of NAV systems is maintenance and repair cost reduction. Assets require cyclical preventative repair as well as repair for damage in handling. Many NAV systems support the identification of required preventative repair as well as status control of damaged assets

5.2 OPERATIONAL CONTROL

The key benefits of RFID based operational control systems are recognized through:

5.2.1 INCREASED PRODUCTIVITY

Most RFID operational systems within the terminal are focused on increased labour productivity. The solutions discussed previously aim to reduce task times or minimise manual data input to improve throughput.

5.2.2 IMPROVED CHE UTILISATION

Increased visibility of assets gives system planners the opportunity to improve asset usage. The use of job assignments based on actual, not assumed, position should increase throughput and decrease travel times by as much as 40%.

At the same time, excess assets can be deployed elsewhere or eliminated.

5.2.3 IMPROVED PLANNING

Better visibility to asset location and condition allows system planners to assign tasks more optimally.

5.3 SAFETY AND SECURITY

The key benefits of RFID based safety systems should be measured through:

5.3.1 INCREASED VISIBILITY

Equipment operators often cannot see personnel on the ground. Using RFID for detection of personnel with corresponding alert mechanisms within the CHE will help prevent accidents.

5.3.2 FACILITY SECURITY

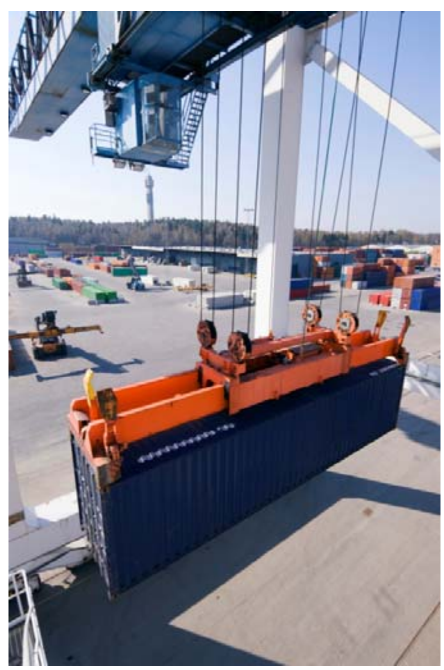
Since 11 September 2001, there has been significant attention focused on improving the security and safety of public venues and facilities. Consideration has been given to monitoring security personnel so that in case of an event, the security person nearest the event can rapidly be contacted to investigate the incident. Organisations have also reviewed how to use technology to provide an additional means of identification that can be used to provide or limit access to specific areas of a facility.

Both for prevention and in dealing with the aftermath of an event, knowing the location of security personnel and visitors may increasingly become a necessity. RFID provides low cost identification of staff for access control as well as locating

5.3.3 ASSET SECURITY

Equally challenging is preventing equipment and assets from 'walking out of gate' There are countless stories of container loss. Being able to detect a potential theft before it happens requires real-time visibility, and information on the location and status of the item.

Additionally, that information must be integrated into the existing host systems so that decisions and actions can be taken in real time. RFID enables this to be achieved.



APPENDIX 1: TERMINOLOGY

AIDC	Abbreviation for Automated Identification and Data Collection, a term used to denote a range of technologies for automated identification and tracking
Active	RFID tags with a battery for power
Beacon	The process whereby a tag sends its data unilaterally
CSD	Abbreviation for Container Security Device, an advanced device to secure containers which may be RFID based
E-seal	Electronic seal consisting of RFID tag with tamper signal
Frequency	The wavelength at which a tag sends/receives data, typically 125 KHz to 5.6 GHz
GPS	Abbreviation for Geo-spatial Positioning System, a method for determining location using satellites
ISO	Abbreviation for International Standards Organisation
ISO 18000-7	Standard for active tag protocol and frequency
Middleware	Software which communicates to and manages readers for collection, filtering, aggregation and formatting of data
Passive	RFID tags with no battery: power to broadcast/receive data is supplied by reader
Protocol	The language by which a tag communicates data to a reader
Read only	A tag type where tag data is programed at factory and cannot be modified
Read write	A programmable RFID tag where data can be encoded into and retrieved from tag
Reader	A device to capture tag data
Response	A process whereby a reader interrogates a tag and the tag responds back with its encoded data
RFID	Abbreviation for Radio Frequency Identification, atechnology for automated identification and tracking
RSSI	Abbreviation for Returned Signal Strength Indicator, a measure of tag broadcast strength
RTLS	Abbreviation for Real Time Locating System, a solution for determining tag location using triangualtion
SDK	Abbreviation for Software Development Kit, a means for an RFID reader to talk to a host application without middleware
Semi-passive	Type of tag that is passive but uses a battery in the tag to extend transmission range
Tag	The common name for a transponder
Tag density	The allowable quantity of tags in a reader area where simulataneous polling can occur
Transponder	An electronic chip with ability to store and broadcast data
Zone	The coverage area of an RFID reader

ABOUT THE AUTHOR AND PEMA

ABOUT THE AUTHOR

Michael Dempsey is Director, Ports, Marine and Intermodal Operations for Identec Solutions, a global supplier of active RFID systems in the marine, automotive, defence, oil, gas and mining and aerospace sectors. He currently serves as Chairman of PEMA's Technology Committee.

Michael has more than 15 years of experience in RFID and process automation technologies and is a recognised industry thought leader in this area. Previously, he was VP Automation Technologies for Navis, a global leader in marine terminal operating systems. Before this, he was VP Strategy and Business Development for RedPrairie Corp, where he was responsible for the development of its RFID practice. He also served as Executive VP for TrenStar, an RFID-enabled asset management solution provider and was co-founder and principal of eSYNC, a supply chain consulting and system integration services provider.

ABOUT PEMA

Founded in late 2004, the mission of PEMA is to provide a forum and public voice for the global port equipment and technology sectors, reflecting their critical role in enabling safe, secure, sustainable and productive ports, and thereby supporting world maritime trade.

Chief among the aims of the Association is to provide a forum for the exchange of views on trends in the design, manufacture and operation of port equipment and technology worldwide.

PEMA also aims to promote and support the global role of the equipment and technology industries, by raising awareness with the media, customers and other stakeholders; forging relations with other port industry associations and bodies; and contributing to best practice initiatives.

MEMBERSHIP

PEMA membership is open to:

- Manufacturers and suppliers of port and terminal equipment
- Manufacturers and suppliers of components or attachments for port equipment
- Suppliers of technology that interfaces with or controls the operation of port
- equipment
- Consultants in port and equipment design, specification and operations

Please visit www.pema.org for more information or email info@pema.org

PEMA was constituted by agreement dated 9 December 2004 as a non profit making international association (association internationale sans but lucratif /internationale vereniging zonder winstoogmerk)

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