

White paper

## **Imaging Adds Visibility to Transportation**

## **How imaging technology can improve visibility and control of assets, inventory and resources**

Many transportation and trucking companies have improved their efficiency by using mobile computing to quickly and accurately identify items and capture data. Most mobile computing technology improvements have been incremental since companies started scanning bar codes on shipping labels and related materials. That has changed now that advanced imaging technology is available in mobile computers. Today, transportation and distribution companies can use the same device to read bar codes and to capture and communicate images in real time. Imagers create a foundation for process improvement to enhance visibility, accuracy and control over shipments in transit.

The visibility that imaging provides is transforming transportation operations. This year 64 percent of trucking companies are using or planning to implement mobile imaging and proof of delivery (POD) systems,<sup>1</sup> which were relatively rare just a few years ago. Companies have created new processes that use images to gain insight into activity that occurs outside their facilities and to improve customer service.

Proof-of-delivery is one of the most popular and effective uses for imagers, but the technology can be used many other ways. Imagers can be used like digital cameras to record the condition of consignments at pickup and delivery and to document problem conditions such as locked gates, blocked dock doors, accidents and other incidents. Imagers can also be used like a document imager in the back office to scan paper documents and signatures into electronic images that are clear enough to fax and archive in electronic records systems.

Imagers can seamlessly replace bar code laser scanners to support current operations while giving organizations the flexibility to create efficient new processes. Laser scanners are excellent at what they do, but what they do is limited mostly to scanning linear 1D bar codes. Imagers read linear bar codes, so they can replace existing scanners with no impact on existing software and processes. However unlike lasers, imagers also read two-dimensional (2D) symbols, which enable companies to use 2D shipping labels.

This white paper examines how mobile imaging technology works and how it can be integrated with existing systems to improve productivity, reduce errors and raise customer service in delivery and distribution operations.

### **Using Imaging in Transportation**

In transportation, a picture is worth improved service, reduced losses and more to companies who use imagers in their over-the-road operations. For example, the value can come from capturing the information needed to provide proof of delivery, documenting service performed, enabling faster invoicing, or improving count and condition monitoring. Images captured in the field can make transportation operations transparent to the enterprise, dispatch operations and customers.

These benefits help explain why so many trucking companies are adopting mobile imaging. Before imagers, evolutionary changes in bar code reading technology did not create many opportunities to make significant new service and productivity improvements. The following passage from the eyefortransport research report highlights the situation:

*“With nearly 100% of North America’s trucking fleets employing some form of wireless & mobile technology, and many companies using third or fourth generation technologies, the focus for fleets is not whether to invest in technology, but how to upgrade their existing systems and learn from mistakes they have already made.”*

Imaging helps companies to do things that are truly new and differentiating. It provides the opportunity to easily upgrade existing systems (because of its seamless support for legacy bar code formats) while supporting efficient new processes. The number of companies using or planning imaging and proof of delivery systems for 2008 increased by 20 percent from eyefortransport’s 2006 study, the largest increase of any technology. The following are some of the applications that are driving imaging growth and operational improvements in distribution.

### **Proof of Delivery**

Proof of delivery is a natural application for imaging that lets organizations go beyond the common process of recording when a delivery was made and who signed for it to include a visual record of the condition of the goods at the time they were delivered. Drivers use an imager embedded in a handheld computer to take a picture of the shipment at the delivery location. The image is used to enhance existing POD processes, such as having the customer sign for the delivery on paper or on the mobile computer screen, and/or recording the delivery by scanning a bar code on the shipping label or other documentation (which can also be done with the imager). The image of the delivery is appended to the transaction record in the mobile computer, complete with a date and time stamp. The entire record, image included, can immediately be uploaded to the back office over a wireless network for real-time access by customer service or other departments, or transferred later in batch.

Many companies will benefit by using images to support POD. Images that document that shipments were delivered in good condition are valuable resources for resolving disputes and reducing losses. Companies that are required to provide proof of successful, damage-free deliveries before they invoice for the shipment can use imagers and mobile computers to provide the documentation in real time. The practice could potentially cut days out of the billing cycle if it replaces a manual invoicing process, thus improving cash flow and reducing the ROI period for the imaging solution.

There are several simple variations to the proof-of-delivery process to extend the benefits of documentation. One is to capture images of shipments picked up for consignment, so the carrier can prove it is not liable for damage that occurred before it took possession. Another is to document that condition that prevented a pickup or delivery being made, such as a locked gate, flooded road or angry dog. These applications provide the documentation needed to prevent confusion and to answer customer inquiries.

### **2D Shipping Labels**

Two-dimensional bar codes on shipping labels are highly effective for preventing errors and eliminating confusion in cross docking, truck loading, delivery and receiving operations. These bar code-based processes are well proven and fairly widely used.

<sup>1</sup> “The Use of Wireless & Mobile Technology in Fleet Operations. Comparative Analysis 2007/2008” eyefortransport, November 2007.

Two-dimensional bar codes have enough data capacity to serve as portable databases (see sidebar on the next page). They are used to add intelligence to shipping labels and break the dependence on networks and database access. 2D labels can include descriptions of the shipment contents, handling instructions, PO numbers and other information that delivery drivers and receiving personnel need to process shipments without having to access a computer or call for instructions.

Here are brief overviews of some of the ways imagers and 2D shipping labels are used in distribution.

**EDI backup or replacement** -- Many companies won't receive shipments unless they have prior notification and can match the shipment with open orders, PO numbers or other records. Electronic data interchange (EDI) facilitates these operations, particularly the 856 Advance Ship Notice (ASN) message. 2D shipping labels can provide the documentation needed to efficiently receive shipments whether or not EDI or other records are available. The space available for 2D bar codes on shipping labels is sufficient to encode EDI ASN data, so it can be scanned as an alternative to receiving a prior electronic submission. 2D bar codes can also encode PO numbers, order numbers, and part number of items packed inside the pallet.

**Master label/bill of lading** -- Another common use is to encode the serial numbers of cases packed within a pallet in a 2D bar code that serves as a master label for the entire pallet. This practice enables a customer or cross dock facility to scan a single 2D label to record the contents of the pallet, rather than having to break it down to scan each individual case or part. This application can also benefit shippers because the master label can be created automatically by scanning individual carton bar codes as they are loaded. The individual scan data can be used to automate shipment verification to prevent orders from being released with wrong items, missing items or excess quantities.

**Delivery instructions** -- 2D symbols can encode plain text, which a handheld computer with integrated imager can decode and display on the computer's screen. This capability makes it easy to give drivers a convenient reference for delivery instructions, such as "Only deliver to dock door 1," or "Customer must sign for delivery." Drivers unsure of delivery requirements can read a bar code in the field, rather than having to call the office for help.

## 2D Basics

2D symbols can encode more data than 1D bar codes of the same size, and can encode the same amount of data in much less space. 2D bar code symbologies encode information on the X and Y axes, unlike traditional linear bar codes, which only use one dimension. 2D symbols therefore can hold exponentially more information than similar-size linear bar codes, and can be used to encode data on crowded labels, small items and other areas where there isn't space available for a traditional bar code.

There are two main categories of 2D symbologies – stacked and matrix – and many individual symbologies. The primary differences between stacked and matrix symbols are how they are encoded, and how they can be read. Laser scanners can read some stacked symbologies but cannot read matrix codes. Imagers can read both, plus traditional 1D codes.

**Stacked** symbologies are made up of two or more rows of linear bars and spaces. They take their name because they can resemble a series of small linear bar codes that have been stacked on top of each other. Leading stacked symbologies include PDF417, Code 16K, Code 49 and a version of GS1 DataBar formerly known as RSS Composite.



PDF417, a common stacked symbology.



GS1 DataBar Composite is one of a few symbologies that combine 1D and 2D elements in a single bar code symbol.

**Matrix** 2D codes encode data in dark and light geometric elements arranged in a grid. The position of each element relative to the center of the symbol is a key variable for encoding. Matrix symbologies are most commonly used for small item marking, and also for unattended and high-speed reading applications. Common examples include Data Matrix, Maxicode, Aztec Code, Code One and QR Code.



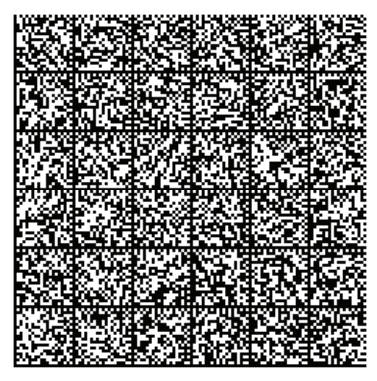
Data Matrix, a leading matrix symbology.

Matrix symbologies are decoded by processing the complete image to determine each element's relative position. Laser scanners cannot read matrix codes because they can't view the entire image at once – area imaging is the only bar code scanning technology capable of doing so.

For comprehensive information about 2D technology, including descriptions of leading symbologies, guidance on how to choose, and information on 2D standards in various industries, see Intermec's white paper Sizing Applications for 2D Barcode Symbols, which is available as a free download from [www.intermec.com](http://www.intermec.com).

## 2D Symbols as Databases

Because of their ability to compress and encode text, 2D bar codes are sometimes used as "portable databases" that mobile workers can reference to check delivery instructions, configuration and service histories, order information and other records. The complete Gettysburg Address is encoded in the DataMatrix 2D symbol below, which measures approximately 1.8 by 1.8 inches. For comparison, the same text is also presented at the right in common 9-point type. The text box measures 3.5 by 3.5 inches.



*Fourscore and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation or any nation so conceived and so dedicated can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting-place for those who here gave their lives that nation might live. It is altogether fitting and proper that we should do this. But in a larger sense, we cannot dedicate, we cannot consecrate, we cannot hallow this ground. The brave men, living and dead who struggled here have consecrated it far above our poor power to add or detract. The world will little note nor long remember what we say here, but it can never forget what they did here. It is for us the living rather to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us -- that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion -- that we here highly resolve that these dead shall not have died in vain, that this nation under God shall have a new birth of freedom and that government of the people, by the people, for the people shall not perish from the earth.*

## Signature Capture -- Paper or Electronic

Handheld computers with touchscreens have proven to be a great resource for resolving delivery disputes. Customers can sign for the delivery right on the computer, which creates an electronic image of the signature. The signature is appended to the transaction record to document proof of delivery. The process is very effective, but may occasionally be limited because some companies and regional laws do not accept electronic signatures as legally binding. These restrictions force the use of paper documents, however the restrictions commonly do not prevent companies from taking advantage of electronic document processing. This is important because some handheld imagers are capable of scanning signed, paper forms into legally valid electronic documents. These documents are clear enough for faxing, archiving, billing and posting to the web and can be used for e-mail based processes. By having electronic images readily available and posted to the website, you can reduce the number of inbound phone calls to your customer service organization. Additionally, you can reduce or eliminate the administrative tasks of manually handling paper documents used for proof of delivery including filing, faxing, scanning or e-mailing these documents.

## Document Capture

It is important to remember that imagers are not synonymous with digital cameras. Bar code reading capability is one key difference, but not the only one. Area imagers developed for enterprise use can include sophisticated image control and enhancement software so scanned documents can be clearly read, faxed, archived and used. Getting usable document images from a digital camera is very challenging -- try it yourself. Professional-class imagers include image control features such as brightness, contrast and angle correction to ensure that the resulting image can be used for online applications, or reproduced on paper if necessary. Figures 1 and 2 below highlight these features. The images were taken of the same document from the same angle. The image in Figure 1 was taken without image control and correction, the image in Figure 2 was taken with a professional-class imager with image control features.

Figure 1:  
Raw Document Image without Image Control Features Applied

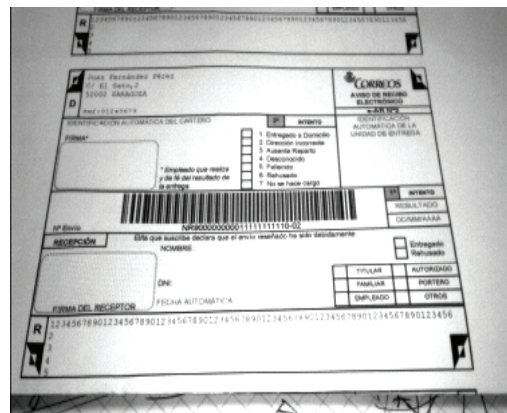
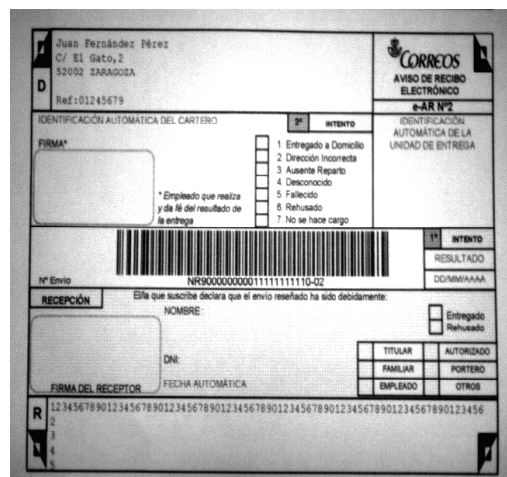


Figure 2:  
Document Image Taken with an Imager with Image Control Features



Generally, a photograph is not commonly usable for business because it can't be printed on paper to clearly resemble the original document. A picture of a document looks like just that - a picture of a document. For business purposes, cameras cannot be used as imagers, but imagers can be used as cameras.

Mobile imagers give workers a fast and reliable way to convert paper documents into electronic forms. Scanning allows drivers to access manifests, bills of lading, delivery receipts and other documentation from mobile computer memory. This is much more convenient than carrying around physical paperwork, and is much less susceptible to being lost or damaged. Electronic document capture also streamlines back office operations and reduces data entry time, because document images can be transmitted from the field directly to backoffice applications over wireless networks. Customer service and other staff thus gain real-time access to document images, via the enterprise systems, which can be used to answer customer queries, issue invoices, and update records.

### **Count & Condition**

Imagers can provide an excellent enhancement to processes that validate items being loaded onto a truck, picked up for delivery, or delivered at the customer location. Today these processes may be automated with checklist-type applications where each item to be loaded or unloaded is bar coded. Each bar code is scanned, which signals the host application to verify whether or not the item belongs with the shipment. The process is effective for preventing shipping errors, but could be more efficient and comprehensive. Imaging helps in the following two ways.

1. Because imagers can read bar codes in any direction and allow generous scan angles, items can be processed faster. Imagers can read most symbologies available today, allowing you to read bar codes applied by your customer in addition to the bar codes you applied. This enables you to provide more detailed information regarding the delivery.
2. Imaging also documents the condition of the item, a critical element missing from traditional applications. By utilizing the imager to take a photograph of the item or of a pallet of items, you're able to document the condition of the shipment in addition to the status of the shipment.

### **Accident/Incident Reporting**

The ability to document conditions is also valuable when accidents and damage to vehicles, equipment or facilities occur. For example, imagine a driver is involved in a fender bender. Using an imager, the driver takes pictures of the damage sustained by the other vehicle and may also document the incident more thoroughly by capturing images of license plates, drivers' licenses and other pertinent information. If the owner of the damaged vehicle submits a suspicious repair bill or insurance claim, the time-stamped images taken at the scene can be used to contest the submission so companies only have to pay for what they are truly responsible for. By visually documenting pertinent information at the scene of the incident, you can equip your safety team with comprehensive information to mitigate potential liability. Companies can also use image capture to document dangerous conditions that resulted in injuries to its workers or damage to its vehicles or equipment such as adverse or poorly marked road conditions

### **Conclusion**

Imaging technology is all around you, from the copy machine you use at the office to the scanner you added to your home computer. New uses emerge every time imaging technology becomes more capable and more compact. Imaging has evolved to surpass laser scanning in performance for all bar code reading applications, and now is gaining adoption in delivery and distribution operations because of the added visibility, versatility and value it provides. Companies are replacing legacy scanners with imagers at unprecedented rates because imagers integrate seamlessly to read all the same bar code formats as previous scanners, and provide the ability to create image-based processes that couldn't be done before. Image-based processes deliver return on investment by making drivers more efficient, and delivering the documentation needed to prevent false claims, resolve disputes and improve customer service.

Intermec, the innovator of imaging technology in data collection, provides a full range of bar code, image capture, mobile and wireless computing and other technologies, and has worked with thousands of distribution, delivery and warehouse professionals to find the right mix of technologies and processes to improve their businesses. Intermec's imagers provide the image quality needed for proof of delivery, document capture and other image-based applications. For example, Intermec's EX25 is the first imager that can decode 1D and 2D bar codes ranging from 6 inches to 50 feet, in any orientation. The EX25 is available integrated with ruggedized handheld computers or in separate handheld scanners.

Intermec Inc. (NYSE:IN) is a leader in global supply chain solutions and in the development, manufacture and integration of wired and wireless automated data collection, Intellitag® RFID (radio frequency identification), mobile computing systems, bar code printers and label media. The company's products and services are used by customers in many industries to improve productivity, quality and responsiveness of business operations, from supply chain management and enterprise resource planning to field sales and service. For more information, visit [www.intermec.com](http://www.intermec.com).

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