The Data Center

Location and the RFID Tag Read Event: An Important Data Element for Supply Chain Systems

David L. Brock, Stephen Miles, and Edmund W. Schuster

The Data Center, Massachusetts Institute of Technology, Building 35, Room 234, Cambridge, MA 02139-4307, USA

ABSTRACT

Every day, there are countless productive opportunities lost in commerce because of a lack of interoperability concerning the data exchanged between organizations. One of the fundamental aspects regarding the long-term goal of achieving interoperability for data is the adherence to a common standard with an industry and between industries. The emergence of Auto-ID technology offers the opportunity to gather data from a number of different read points within supply chains. To make this data interoperable between organizations, the data captured at the time of reading an RFID tag must be common for all those using the technology. Specifically, a standard for the location of a read event is becoming a significant issue that industry must come to common agreement. This article discusses the issues surrounding the development of a common standard for location.

ABOUT THE AUTHORS

David L. Brock is Principal Research Scientist at the Massachusetts Institute of Technology, and co-founder and a Director at the Auto-ID Center (now EPCGlobal, Inc. and Auto-ID Laboratories). The Center was an international research consortium formed as a partnership among more than 100 global companies and five leading research universities. David is also Assistant Research Professor of Surgery at Tufts University Medical School and Founder and Chief Technology Officer of endoVia Medical, Inc., a manufacturer of computer controlled medical devices. Dr. Brock holds bachelors' degrees in theoretical mathematics and mechanical engineering, as well as master and Ph.D. Degrees, from MIT. Dave can be reached at dlb@mit.edu

Stephen Miles is Team Leader WAN Services SIG, a research program at MIT. Prior to his work at MIT, Steve was enrolled in the Management of Technology executive program at MIT Sloan and served as a consultant in value added IP services strategy to leading service providers in the US and Europe. Before MIT Steve was Co-founder and Vice President of Business Development at Wireless IP Networks. Previously Steve served as Vice President of International Sales with IronBridge Networks. For over four years Steve served in a variety of executive roles with NMS Communications (NMSS), a supplier of Windows and UNIX based enabling technology to wire line and wireless OEM's including Alcatel, Ericsson, Lucent, NTT, Siemens; NMS grew from $20M to $250M during this period. Steve was also Founder and President of Officenet Inc., a computer services company with customers including American Express and General Electric, which he sold to Decision One in 1996. Steve served as founding member of The National Computer Services Network IWSA Chapter and as executive committee member of the AFSM Minuteman Chapter. Steve participates in W3C, OASIS and WS-I standards organizations and is a frequent speaker at RFID Conferences. Steve can be reached at s_miles@mit.edu

Edmund W. Schuster has held the appointment of Director, Affiliates Program in Logistics at the MIT Center for Transportation and Logistics and is currently working at The Data Center. His interests are the application of models to logistical and planning problems experienced in industry. He has a bachelor of science from The Ohio State University and a master in public administration from Gannon University with an emphasis in management science. Ed also attended the executive development program for physical distribution managers at the University of Tennessee and holds several professional certifications. Ed can be reached at Edmund_w@mit.edu

1. INTRODUCTION

While applications of Auto-ID are still developing with many firms beginning the pilot-testing phase, there exists a need for basic research involving the issue of how to handle all of the data anticipated from this new technology. An area of particular interest involves the type of data to capture during the reading of RFID tags. The decision (and potential standard) involving data capture must consider the potential uses of the data in a host of downstream computer systems needed to run modern organizations, including the need to achieve supply chain wide visibility for tracking and tracing.

As companies conduct initial implementations, questions arise concerning the time and location of the read event, and the association of this data with the Electronic Product Code (EPC). These issues ultimately determine how EPC data will be used in basic information and transaction systems, such as Enterprise Resource Planning (ERP), that serve as the bedrock of commerce for a wide range of industrial firms (Schuster et al. 2005).

An important feature of the supply chains of the future will involve the location of objects that might be stationary or in motion anywhere within or beyond the organizational boundaries for a company. Having a common identifier for location will help greatly in the sharing of data between organizations and various supply chain functions.

This article explores the issue of defining location in a robust way to meet the needs of the supply chain community. Progress in analyzing and making sense of data will only occur if common standards facilitate efforts to integrate data. Without a standard for location, efforts to establishing interoperability, even on a limited basis, will become extremely difficult to achieve.

In the next section, a simple example is put forth to demonstrate the complexity of location. Later sections deal with the importance of location in day-to day commerce and a brief discussion of a proposed approach for the consumer goods industry. The conclusion integrates the main issues of the article and makes the case for a universal standard for location.

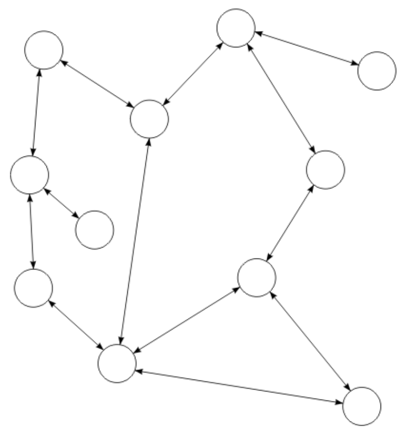
2. AN EXAMPLE FROM THE CONSUMER GOODS INDUSTRY

The complexity in designing a standard code structure for location arises because in almost all cases the location of an object is relative to something else. Since commerce is composed of a large number of objects, fixed and moving, location has a vast number of answers depending upon the frame of reference used. Further complicating matters, location is described with words that can have multiple meanings depending on the industrial context. No single semantic definition exists for many words used to describe location.

An example of this complexity involves the simple question "Where is my shipment?" Does this mean where is the shipment along its route? Or, where is the shipment on the earth - latitude, longitude and altitude? Alternatively, where is the shipment inside its shipping container?

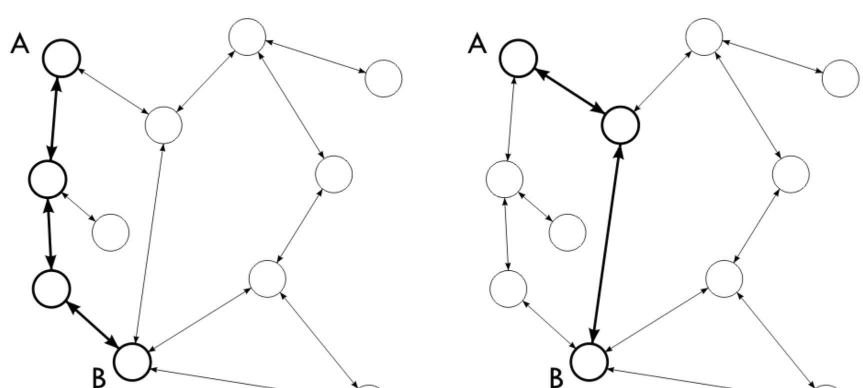
To answer these questions, it is best to begin by visualizing objects as nodes in a network and location as relations - or links - between the nodes, as shown in Figure 1. The location of an object may have many different and equally valid answers. Each answer represents a particular pathway through the network between two objects.

Figure 1. Location as pathways through a network of object relations



The location of one object - say object A relative to another object B - can be represented as a path through the network of positional relations (see Figure 2). For each situation, a set of valid paths exists that correctly locates an object.

Figure 2. Location as a pat' through a network of objects



The answer to the question "Where is it?" could be as simple as a list of nodes, or a list of nodes together with some or all the relations between the nodes. For example, suppose a logistics manager asks, "Where is my shipment of P&G Bounty Paper Towels?" The answer might be "Your shipment is in the Proctor and Gamble Manufacturing Center, Cape Girardeau, MO, USA."

This phrase can be decomposed into a list of objects or nodes that include: (1) My shipment, (2) Proctor and Gamble Manufacturing Center, (3) Cape Girardeau, (4) MO (Missouri), and (5) USA. Each of these nodes is progressively larger, containing its immediate predecessor, as we move from the more specific to more general. Therefore, one expression of location is the P&G Manufacturing Center, in Cape Girardeau, in Missouri, in the United States of America. In this example, the address may be sufficient to identify location for most business purposes. The exact location of Cape Girardeau within Missouri is not needed.

RFID tags containing the Electronic Product Code (EPC), along with Auto-ID infrastructure, provide the potential for more detailed information about location. Using another example, when inquiring about a particular item - say a package of P&G Ultra Downy Mountain Spring (epc:id:gid:37000.35830.344098943) - located in a case (urn:epc:id:sgtin:37000.800031.400) on a pallet (urn:epc:id:sgtin:0652642.800031.400), one may receive the following response:

"Your item
epc:id:gid:37000.35830.344098943
is located in case
urn:epc:id:sgtin:37000.800031.400
is located on pallet
urn:epc:id:sgtin:0652642.800031.400
which is on the
Top shelf
Shelving Unit 'C'
Proctor and Gamble Manufacturing Center
Cape Girardeau, MO
USA."

From this example, it is easy to see that a robust solution to the location issue contains a number of different elements: (1) address, (2) logistics containment, (3) spatial location, and (4) geo-position. Connecting these elements in a standard way that is portable across different industries is a challenging task. However, achieving this task is a fundamental building block in gaining supply chain visibility and for establishing the base for long-term goals such as automation.

In the next section, visibility takes on a more tangible form as several examples of its significance in business situations are examined.

3. THE IMPORTANCE OF LOCATION

Increasingly manufacturers are being held responsible for accurate accounting of goods that flow through distribution partners to the end consumer. This might include pedigree tracking as a means of reducing counterfeit, or providing accurate records for taxation purposes. In both cases, a common definition of location becomes essential to generating a robust tracking and tracing capability.

For example in February 2004, the Food and Drug Administration (FDA) announced a guideline that recommends identification of drugs by using such technologies as Auto-ID to trace the movement of medicines through complex supply chains (Mathews 2004). With the data for each owner of a drug as it passes through the supply chain, a pedigree could be generated showing the entire history of movement and the time spent at each location. If pedigrees accompany each shipment through the supply chain, it is less likely counterfeit will occur because buyers will not purchase pharmaceuticals with a suspicious history of movement.

The state of Florida in the U.S. has been a leader in implementing paper pedigrees for pharmaceutical products. California has gone a step further in passing an ePedigree law requiring that all paperwork be computerized to reduce the chance of paper forgeries. The FDA recommends full implementation of track and trace capabilities for all pharmaceuticals distributed in the US by January 2007 (Mathews 2004).

The European Union provides another example of imposed requirements for track and trace. In this case, the initiative involves verification of Value Added Tax (VAT) collection. In July of 2004, the world's top tobacco company, Philip Morris, agreed to pay $1.25 billion to the European Union over 12 years to fight contraband cigarettes and end legal disputes with the EU over smuggling charges. Regulators in Europe have been holding the manufacturer (in this case Altria Group, parent company of Kraft Foods, Philip Morris International, Philip Morris USA, and Philip Morris Capital Corporation) responsible for control of its supply chain from start to finish, regardless who puts its products in the hands of consumers (Carr, Barrett 2005).

In both cases of implementing tracking and tracing technology for vertical markets, whether tracing drug pedigrees or VAT tax compliance, the need exists for a standard definition of location. Yet there are few location standards in place for specific industries. In no case is there a universal standard that encompasses all of industry.

4. EXISTING LOCATION STANDARDS WITHIN THE CONSUMER GOODS INDUSTRY

One of the main issues in implementing Auto-ID technology is the existence of legacy standards that might be at odds with the new technology. Widely used within the consumer goods industry, the Global Location Number (GLN) is the standard for data shared across the Global Data Synchronizations Network (GDSN). This standard supports the use of all legacy UCC symbolic location reference systems including 196 different coding methods recognized by ANSI X12.[a] With this situation, there currently exists a lack of interoperability using existing bar code technology for non-unique identification of objects within a supply chain.

Going a step further, location becomes an even more challenging information technology issue when RFID tag readers are installed on moving vehicles such as lift trucks within warehouses or over-the-road trucks making deliveries to customers. Current proposals call for a second unique identifier field to be added to the current EPC tag data specification. This new field would be situated between the Location Reference and the Serial Number. Figure 1 provides a visualization of the current EPC specification without the second identifier added. In this case, the second identifier would serve as a unique identifier for each shelf location.

Figure 1- Current EPC Specification

Header	Filter Value	Partition	Company Prefix	Location Reference	Serial Number
8 bits	3 bits	3 bits	20 – 40 bits	21 bits	41 bits

Adding a second identifier for location leads to several important issues in overall system design. Increasing the amount of data captured during the EPC read event is difficult to justify since the EPC number and location identifier are already unique. In addition, a second field for identification of location does not solve the problem of providing accurate location information for a RFID tag that is moving.

Making matters worse, the proposed addition of a second location field would be a direct substitution for legacy distribution center bar code data. The existing GLN AI 414 standards use bar code labels to identify shelf or rack locations within warehouses. As lift trucks put away or remove merchandise, these shelf bar codes are scanned and the location information transmitted to warehouse and transportation management systems, and ERP systems. Through these means, merchandise is tracked through the warehouse based on movement. This provides vital information to update inventory records in real time. Eliminating this data, with replacement of the second identification field thought to be needed for the EPC, will not allow for bar code based tracking within a warehouse. It is true that proprietary standards could be used for adapting currents standards for both bar code and EPC reads, however, this approach will reduce the chances for interoperability.

Within the EPCglobal Software Action Group (SAG) standardization process, the Tag Data Standards (TDS) Work Group is addressing these issues. The current TDS specification indicates how legacy numbering systems such as the EAN.UCC GS1 family of

[a] ASC X12 is the U.S. standards body for the cross-industry development, maintenance, and publication of electronic data exchange standards, based on, but not limited to X12 EDI, XML, and UN/EDIFACT formats (www.x12.org/x12org/about/index.cfm) and the 212 different coding methods recognized by UN/EDIFACT (www.unece.org/trade/untdid/texts/unredi.htm).

codes (GTIN, GLN, SSCC, GRAI, and GIAI)b will be embedded within the EPC. In the future, other industry sectors such as automotive, health care, aviation and defense may call for the embedding of their existing vertical numbering schemes directly within the EPC. This is especially true for applications where it is impractical to map the original General Identifier (GID) format of the EPC into the corresponding identifier numbering system via a simple network lookup.

5. CONCLUSION

This article briefly examined the difficult question; how do we communicate a specific location across industries? Since Auto-ID Technology was designed with the idea of exchanging data across a wide variety of industries and supply chains, the combination of industry specific standards and legacy systems will not provide the solution for complete supply chain wide visibility.

In a recent review of current approaches to the location of physical objects, Becker and Duerr (2005) concluded, "there is no location model that satisfies all identified requirements at the same time." It is important for practitioners to understand that the full potential of Auto-ID technology in creating interoperability will not be realized until development of robust standards for location becomes a reality.

A research program in this area, designed to consider the current realities of legacy data capture systems along with the future needs of industry in terms of the EPC, will go a long way in establishing a standard capable of standing the test of time. One of the first steps in establishing interoperability is to have a common structure for data gathered from the reading of RFID tags. If such a standard can be met, then the potential for sharing data between organizations is great. This opens the possibility of new ways of managing that allow automation and the ability to send instructions to a specific object located within a supply chain. Achieving these new capabilities will only be possible through the detailed work of standards bodies such as EPCGlobal, fundamental research on the topic, and objective input from industry practitioners.

[b] These codes represent the serialized version of the bar code, the Global Location Number, the Global Returnable Asset Identifier and the Global Individual Asset Identifier, a precursor to the Electronic Product Code (EPC). In each case the requirement to communicate this information more generally requires that the Metadata embedded in these numbering schemes be explicit.

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