



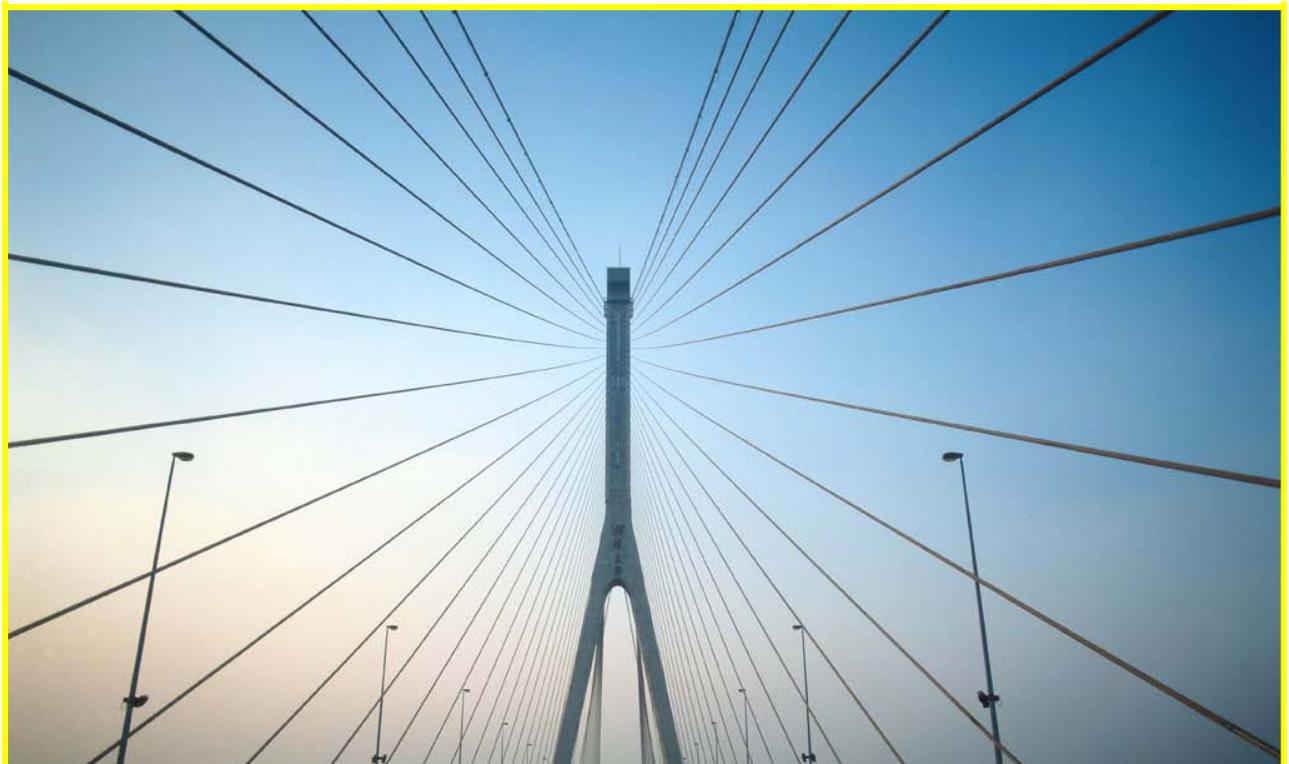
**Building Radio frequency IDentification for the Global Environment**

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## **Application Guideline**

# **Implementation of solutions based on GS1 and EPCglobal standard for Asset Management**

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## About the BRIDGE Project:

BRIDGE (**B**uilding **R**adio frequency **I**dentification for the **G**lobal **E**nvironment) is a 13 million Euro RFID project running over 3 years and partly funded (€7,5 million) by the European Union. The objective of the BRIDGE project is to research, develop and implement tools to enable the deployment of EPCglobal applications in Europe. Thirty interdisciplinary partners from 12 countries (Europe and Asia) are working together on : Hardware development, Serial Look-up Service, Serial-Level Supply Chain Control, Security; Anti-counterfeiting, Drug Pedigree, Supply Chain Management, Manufacturing Process, Reusable Asset Management, Products in Service, Item Level Tagging for non-food items as well as Dissemination tools, Education material and Policy recommendations.

For more information on the BRIDGE project: [www.bridge-project.eu](http://www.bridge-project.eu)

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## This document:

*This document is an application guideline that will provide companies information for implementing GS1 and EPCglobal standards based solutions for improved Asset Management. First off, it will outline market needs and the role of GS1-EPC standards in Asset Management improvement. Secondly, it will detail the technical and organizational changes that result when new solution created for companies in the supply chain are being implemented. And finally it will propose the implementation road map and present the implementation methodology.*

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## 1 Purpose of the document

This document is an application guideline that will provide companies information for implementing GS1 and EPCglobal standards based solutions for improved Asset Management. First off, it will outline market needs and the role of GS1-EPC standards in Asset Management improvement. Secondly, it will detail the technical and organizational changes that result when new solution created for companies in the supply chain are being implemented. And finally it will propose the implementation road map and present the implementation methodology.

## 2 Context

In recent years, the need to improve Asset Management in the supply chain has greatly increased and will continue to grow in the future. There are many explanations for this need, such as costs savings, research of process efficiency, flow visibility improvement, respect of legal requirements, diminution of environmental impacts, etc.

Currently there is no common commitment among supply chain participants to guarantee a better asset control. Only some parties undertake actions and the level of non-commitment from other parties makes it difficult, or even impossible, to improve asset follow-up, even more so since in open loop supply chains. There are certain problems that commonly arrive from this situation, such as the number of asset lost (about 10% per year), oversized asset pools, non-transparency on rental costs, non-identification of the problems starters (damages, unauthorized reuse or loss), number of disputes and tensions between business partners, inefficiency in logistic processes and a substantial number of counterfeited assets (often true with pallets).

Solutions based on GS1 and EPCglobal standards give companies a strong opportunity to tackle the difficulties listed above by improving the visibility on asset flow. Over the course of three years, the BRIDGE WP9 addressed this issue by: studying the market, analysing company needs, testing the technology and standards in a live context during a pilot phase, and proposing a recommendation for implementation. This document is the WP9's final work which was written to disseminate the collective findings of all the analyses done since the beginning of the project in June 2006. It is an implementation guideline that will provide end users with the main information needed to easily implement defined solutions in order to improve Asset Management. This document is associated with three other dissemination documents produced by the WP9 group:

- 9.6.1 Technical Guideline. A document to help solution providers to develop and propose adequate solutions based on GS1-EPC standards for Asset Management
- 9.6.3 Costs/Benefits Analysis. A document to help end-users to address the profitability assessment of the implementation of solutions based on GS1-EPC standards for Asset Management
- 9.6.4 Training Tool Kit. A document to help companies to understand how solutions based on GS1-EPC standards can improve Asset Management

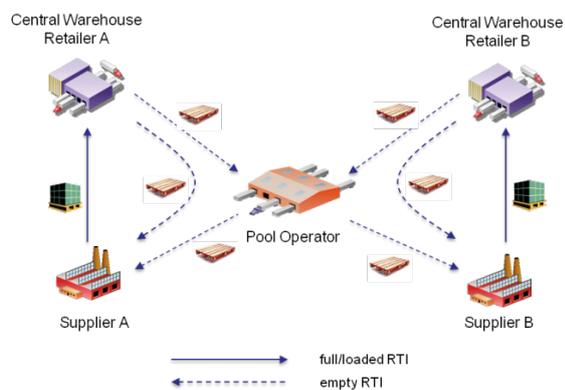
## 3 Who will use this document

This implementation guideline addresses every company in the supply chain who wants to use solutions based on GS1 and EPCglobal standards in order to improve their Asset Management. It concerns pool providers, pool operators, manufacturers, carriers, retailers and logistic providers.

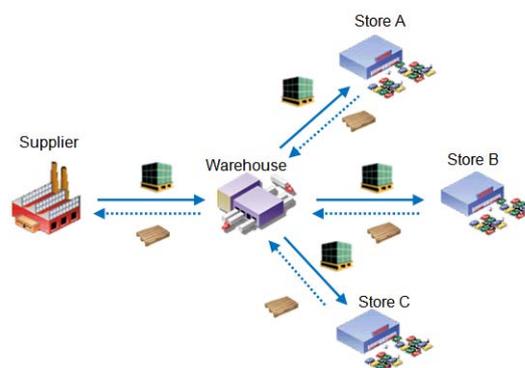
## 4 Market needs more visibility on asset flow

Currently, the most commonly used models of Asset Management in the supply chain are:

- **Pooling model:** Assets are owned by professional pool operators and rented to users. Pool operators manage the movement of their pools between trading partners
- **Exchange model:** Assets are owned directly by their users. They are exchanged in same quantities and quality between trading partners



*Example of the pooling model with pallets*



*Example of the exchange model with pallets*

Whatever the model use, the efficiency of Asset Management depends on visibility. For example, in the pooling model, the pool operator needs to know the inbound and outbound movements of assets being used by companies in order to invoice its customer for the amount of time the assets is stayed at a customer's location. The pool operator needs also to know the final destination of the assets and their pick-up time (empties collection). In the exchange model, the companies have to know the exact number and location of the delivered assets and the exact number and location of the collected assets in order to manage asset trading accounts and balance the difference with their partners.

However, current practices do not allow for much asset identification capture and exchange during the logistic processes, and thus give way to lots of errors and approximation. Therefore, even if they wanted to, companies cannot exchange relevant information concerning the asset flow with their trading partners because they do not have accurate visibility on their own internal flow. In the end, there is no transparency on asset flow and therefore no efficient Asset Management.

In order to improve visibility on assets circulating in the supply chain, three improvements are greatly needed. First, there is a need of identification. Assets can be "traced & tracked" in the supply chain if and only if they are identified with a code. This code is needed for identification so as not to confuse one asset from another during the logistic processes. Secondly, there is a strong need to automate the data capture of this asset identification. Trading partners need to automate their processes in order to improve their productivity (i.e. reduce time per process) and their reliability (better process quality). Finally, because the supply chain is an "open loop" world and Asset Management involves multiple different companies, there is also a need to exchange relevant information concerning assets with trading partners.

## 5 Accurate visibility benefits every companies

Even if differences exist between the Asset Management models, business opportunities brought by accurate visibility on asset flow concern all the companies in the supply chain.

On one hand, better visibility on asset flow gives Asset Management specialists, such as Pool Operators and Pool Providers, the means to carry out their work with ease and efficiency. For example, they will have the opportunity to:

- Adjust their pool size according to the actual demand and at the same time improve reactivity to customer demand
- Improve their processes such as asset delivery, collection and reconditioning
- Identify the problems starters and therefore improve their capacity to fight against asset damages, counterfeiting or unauthorized reuses
- Improve pricing competitiveness (rental, repair, transportation, etc)
- Invoice customers with better transparency and fairness

On the other hand, for the other trading partners in the supply chain such as manufacturers, retailers, carriers and logistics providers, better visibility will provide an opportunity to:

- Improve asset accountability
- Reduce asset over stock
- Optimize exchanges with partners (delivery and collection of empties)
- Reduce number of disputes
- Reduce costs (rental, reconditioning, dispute...)

A detailed analysis outlining the needs and benefits individualized for each company are available in the BRIDGE deliverable 9.5 entitled “Pilot Analysis and Recommendations Report”.

## **6 Role of GS1 and EPCglobal standards in Asset Management**

Solutions based on GS1-EPCglobal standards can improve asset flow visibility by matching all of the three company needs listed above.

First, the Global Returnable Asset Identifier (i.e. GRAI) is used for asset identification on pallets, crates or rolls. Its structure allows us to differentiate an asset by its type (asset type) or by its unique number (serial number).

Secondly, in terms of automated data capture, the two existing solutions are the GS1 128 barcode and the EPC UHF Class1 Gen2 RFID tag. Due to automation (e.g. bulk reading of several assets in the same time) RFID seems to be the best fitted technology and barcodes should only be used for back-up in case of a breakdown.

Finally, for data exchange between companies GS1-EPCglobal propose two solutions:

- EDI messages : Companies that have already established a business relationship can henceforth exchange transactional messages about assets (code, quantity, location, etc)
- EPCIS Events: Companies that may or may not have established a business relationship can exchange asset events created at each steps of the supply chain (code, quantity, location, disposition)

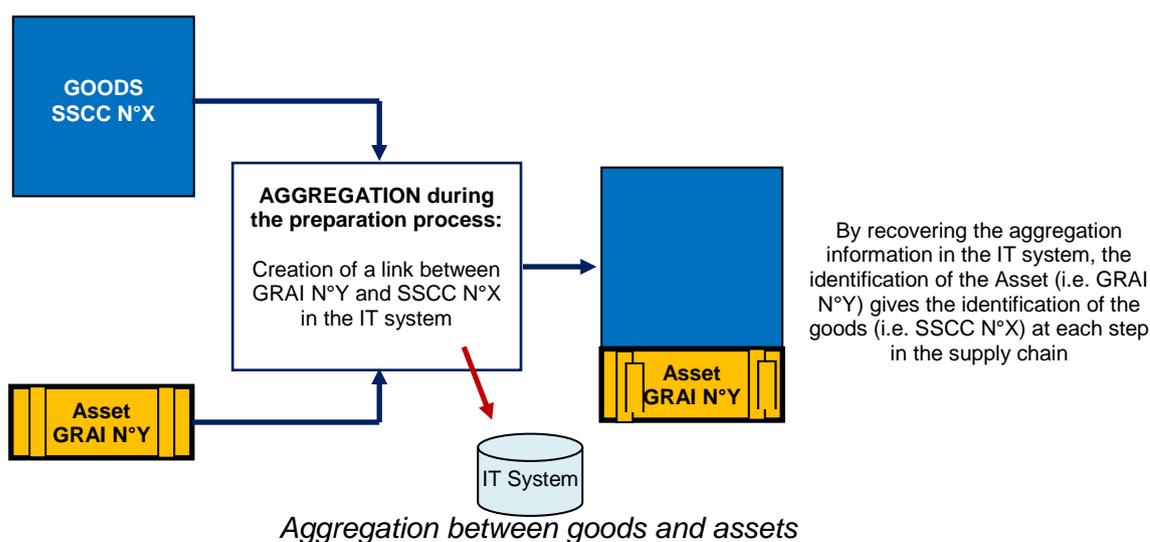
The details of these standards are available on the GS1 and EPCglobal website (i.e. [www.gs1.org](http://www.gs1.org) and [www.epcglobalinc.org](http://www.epcglobalinc.org)) or in the BRIDGE deliverable 9.6.1 entitled “Technical Implementation Guidelines” and 9.5 “Pilot Analysis and Recommendations Report”.

## **7 Asset Management and Supply Chain Management convergence**

Although end-user companies want Asset Management improvement, they are much more interested in Supply Chain Management improvement (out of stock reduction, shrinkage, etc). Indeed, every company in the supply chain needs to track and trace its goods in order to improve the efficiency of its logistic processes such as receiving, storage, preparation (i.e.

aggregation) and shipping, management of its goods flow and registration of traceability information in case of contamination problems.

Solutions based on GS1-EPC standards give companies a great opportunity to address Supply Chain Management in doing Asset Management. Indeed, since an asset is identified with a unique code (GRAI) encoded into an automated data carrier (GS1 128 barcode or RFID Gen2 tag), it is possible to link the code of the goods (i.e. SSCC or SGTIN) with the code of the asset during the preparation process. This association could be done in an IT system and managed in time through the different logistic processes and exchanged with trading partners. In identifying the asset, the company will recover the information about the goods and is capable of achieving Supply Chain Management. Therefore, it becomes possible to track and trace the goods by tracking and tracing the assets by using solutions based on GS1-EPCglobal standards.



## 8 Changes brought out from the implementation of new solutions

Since today apart from the pool providers and the pool operators, trading partners prefer to include the extra-costs due to asset mismanagement with their selling price rather than implement complex procedures or systems for which the Return On Investment (ROI) is not yet evident. Most often assets are counted manually and quantity information is exchanged by fax or by phone. Therefore, although the potential to improve Asset Management is important, so are the technical and organizational changes issued from the implementation of solutions based on GS1-EPCglobal standards.

### 8.1 Technical Changes

On the one hand, technical changes concern companies that have not yet implemented much Asset Management solution, such as end-users (manufacturers, retailer, carrier, etc). On the other hand, technical changes also concern companies that have already implemented dedicated systems for Asset Management, such as pool players (pool providers and pool operators) because most often the systems in place have not conformed to the solutions based on GS1-EPC standards.

Details about technical implementation of hardware and software solutions are available in the BRIDGE WP9 deliverable entitled "Technical Guidelines".

#### 8.1.1 Hardware Infrastructure: how to capture the data

The first infrastructure that companies have to deploy is an automated reader capable of identifying the assets and collect their GRAI. The choice between using barcode or RFID

readers depends firstly on the data carrier fixed to the asset, and secondly on the company's policy on RFID. However, if a barcode seems to be used as a data backup with crates or rolls, it may not be used at all with pallet. Indeed, it will be difficult to fix durably a GS1 128 barcode into wooden pallets. It is therefore conclusive that Pallet Management may only be achievable with RFID and will not provide companies with leniency to choose, like we see in Crate or Rolls Management.

By choosing to use RFID instead of barcodes, companies greatly benefit in terms of:

- **Robustness:** Tags can be identified even if they are buried into the asset. This offers better protection and means that tag durability equals asset life durability
- **Automation:** Identification does not require any human action. As soon as tags enter the electromagnetic field of a reader, their GRAI is automatically registered
- **Bulk reading:** Identification of hundreds of tags at the same time. This presents an opportunity to improve process productivity without reducing reliability
- **Data capacity:** If the asset tag has additional memory it is possible to encode additional data along with the GRAI, such as temperature, batch number, expiration date, or internal data

Companies can deploy three kinds of RFID readers for asset identification:

- **Hand Held reader:** As a manual barcode reader, a hand held reader is a Pocket PC connected to an RFID module and an RF antenna. Even if this kind of reader reduces the benefit issued from automation, it is efficient and sometimes indispensable for processes like inventory or aggregation between the goods and the assets. Moreover, if current barcode readers already used in the company are compatible with RFID, the implementation of just an RFID module and an RF antenna limits the hardware costs
- **Embedded reader:** It is when the reader is embedded onto a vehicle such as a forklift. It is efficient for every process where assets are moved from one location to another such as during truck load/unload or asset stacking onto racks. Another advantage of this kind of reader concerns the implementation costs. There are often less forklifts in a company than shipping gates and therefore the deployment of embedded reader is often less expensive than a deployment of several portal reader (one per each shipping gate)
- **Fixed reader:** It is when the reader is fixed to specific location. Most often the location is a shipping gate, but it could be also a conveyor belt or a rotational table which films the shipping unit. Completely automated, fixed readers are often connected up to multiple antennas (up to four), movement sensors, traffic lights and monitor equipment in order to help operator visual control. This kind of readers offer the better performances for bulk reading such as for example identification of all the crates loaded onto a pallet or multiple pallets moved in the same time by the same forklift

## Estimation of the costs:

HW Component		Unit cost
Tag for metallic roll		10 €
Tag for further assets		0,2 €
UHF Antenna for gates (€/antenna)		260 €
UHF Reader for gates (€/reader)		2.250 €
Movement Sensor for gates (€/sensor)		400 €
Traffic Lights for gates (€/traffic light)		200 €
Monitor (€/monitor)		200 €
UHF RFId module for industrial PDA (€/brandishable)		750 €
UHF RFId stand-alone printer (€/printer)		5.000 €
UHF system per bay		
Component	Quantity	Cost
UHF Reader	1	2.250 €
UHF Antenna	4	1.040 €
Movement sensor	1	400 €
Traffic light	1	200 €
Monitor	1	200 €
Installation	8 h	500 €
<b>TOTAL</b>		<b>4.590 €</b>
Handheld UHF System (brandishable)		
Component	Quantity	Cost
UHF RFId module for industrial PDA	1	750 €
Installation	4 h	250 €
<b>TOTAL</b>		<b>1.000 €</b>
Roll Tagging		
Component	Quantity	Cost
Tag	1	10 €
Installation	1 min	0,25 €
<b>TOTAL</b>		<b>10,25 €</b>
Tagging of further assets		
Component	Quantity	Cost
Tag	1	0,2 €
Installation	1 min	0,25 €
<b>TOTAL</b>		<b>0,45 €</b>

Source: GS1 Italy 2009

The second infrastructure concerns connections between the readers and the company's information system. Whatever the type of reader used, barcode or RFID, they need to be connected with the system in order to transmit the data collected (i.e. GRAI and other data possibly stored in the tag). The connection could be done by using wired or wireless infrastructures (i.e. Wi-Fi, GPRS, etc). However, there are two specificities that apply to connections with RFID readers. Firstly, because of automation, RFID readers need to be connected most of the time in real time with the IT system. Secondly, because of bulk reading capacity, the size of data collected by a RFID reader can be important and connection infrastructures have to therefore be sized enough in order to operate efficiently.

### 8.1.2 Software Infrastructure: how to consolidate, use and exchange the data

The first software infrastructure to be implemented concerns the RFID middleware. To get the most out of their RFID systems, companies will have to deploy a new kind of middleware. This is a new breed of software that sits between the readers and IT infrastructure. Since the RFID middleware is positioned directly in contact with the physical hardware, it can perform a vital data filtering and aggregation function, by helping to cut down on the data volume moving further up the pipe and closer to company systems. By inspecting the data upon initial capture, and applying some business rules, it can help to turn raw data into actual meaningful information that constitutes real events and transactions. The key functions of RFID middleware are cross-platform hardware integration and data reduction.

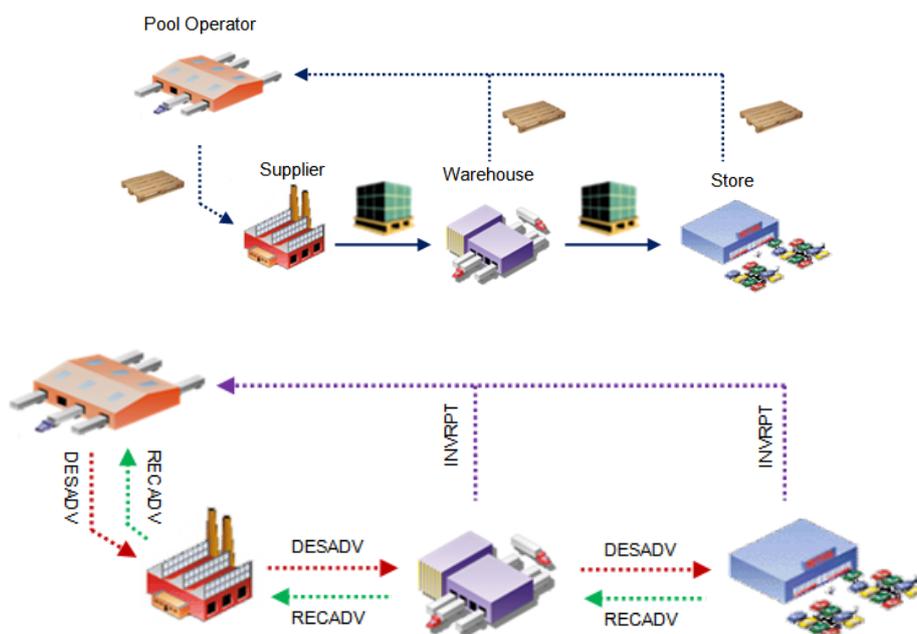
Secondly, companies must have software capable of achieving Asset Management. For companies already equipped with Asset Management software (such as pool players and some end-users), the modifications will include the evolution of the software in order to use the data collected by the automated reader and the middleware. Companies with no Asset Management software will have to invest in one.

Thirdly, because the supply chain is an open loop world, companies need to exchange relevant data concerning the asset flow with interested parties such as pool players or trading partners. Therefore, the modifications will affect the method of data exchange. Two complementary solutions based on GS1-EPCglobal standards already exist.

The first solution is to use EDI messages. Initially, the EDI messages did not permit the exchange of GRAI codes. However, in recent months, GS1 has led the initiative to alter the existing messages in order to manage GRAI codes and therefore assets. On the one hand, this solution presents important advantages since many companies already deploy EDI infrastructure and already exchange EDI messages with their partners. As a result, the technical alterations required in order to integrate the GRAI into existing messages are not so significant and therefore will not be very expensive. On the other hand, this solution is limited. Firstly, companies must have already established a business relationship before being able to exchange EDI messages. This is a problem since assets are used in an open loop system because they circulate between companies that do not necessarily have an established business relationship. Secondly, EDI messages are transactional. They follow the supply chain and are exchanged at each step between one company and its partner. Therefore, if a company breaks the chain upon exchange, the information cannot be transmitted to the next partner. This represents a problem for example as soon as the information regarding aggregation between asset and goods is not transmitted to a company that wants to track and trace the goods by tracking and tracing the assets.

Among all the messages standardized, three main EDI messages are useful for Asset Management:

- DESADV: The message used to alert the trade partner that he will soon receive assets and to detail the traceability of the loaded goods (SSCC, SGTIN, batch number, etc)
- RECADV: The message used to acknowledge that assets and goods were received. It offers:
  - Acknowledgement receipt of assets and goods
  - Information about discrepancies between received and accepted quantities and dispatched quantities (data found in the DESADV message).
  - Information or instructions proving delivery arrival or outlining other measures that have to be taken because of identified discrepancies
  - Instructions establishing the credit note. The point of delivery may also correct internal invoices that have been resold or dispatched to another client
- INVRPT: The message used to communicate stock status. It gives an inventory report at a certain point in time. It also allows the identification of all events that influence the quantity and the quality of the stock, as well as the summary of movements by listing of all the movements that have occurred over a certain period of time.



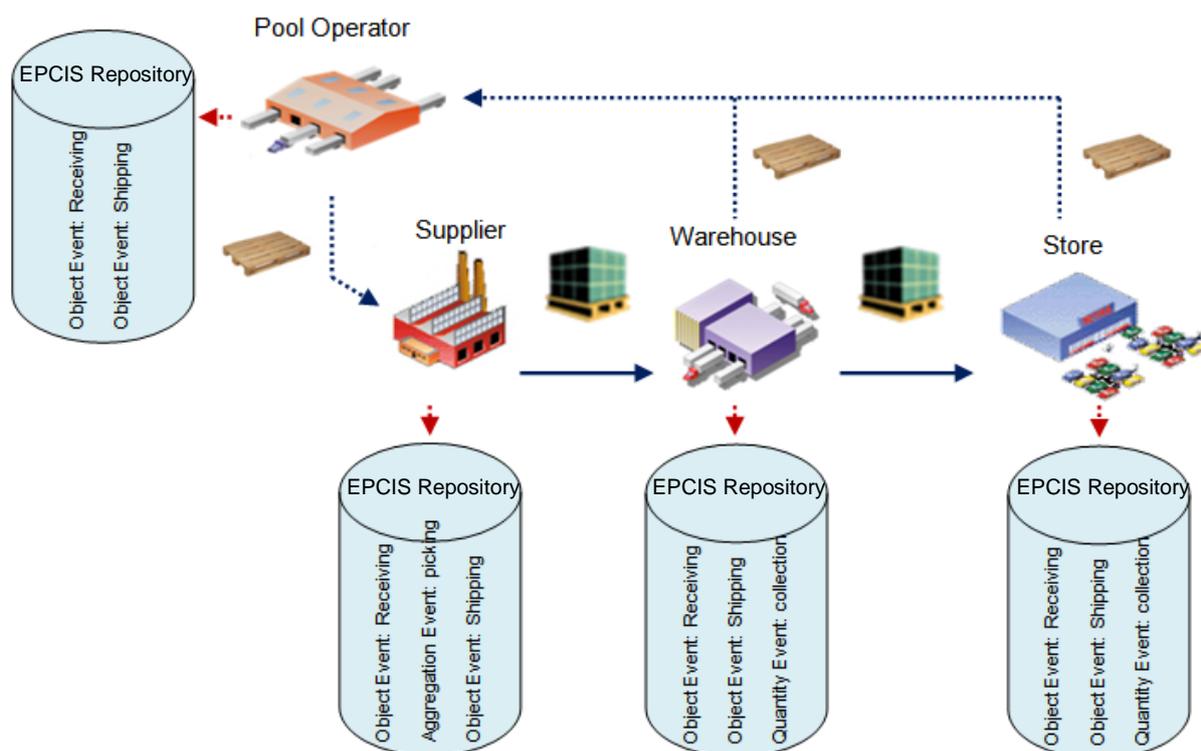
The second solution is to use EPCIS events. The EPC model is based on events created by the companies at each step of the supply chain and on the research and the exchange of these events between partners to get the maximum of visibility on flow. On one hand, the greatest advantage presented by this solution is the possibility companies have to recover the data available from the EPCIS Repository of a trading partner. For example, this is useful to a company in need of aggregation information between goods and assets in order to achieve Supply Chain Management, or to a pool operator in research of the location of its empty assets in order to launch collection. On the other hand, contrary to EDI messages, this solution is not yet implemented into companies. Technical changes for the IT systems are more significant and implementation costs will be more expensive.

An EPCIS event is composed of four main details:

- **WHAT:** the product concerned by the event (GRAI, SSCC, SGTIN, etc)
- **WHERE:** location of the event
- **WHEN:** time of the event
- **WHY:** the business step where the event occurs and the disposition (i.e. the status) of the product immediately after the event (e.g. empty and available for collection)

Four events are exchangeable between partners:

- **Object Event:** Describes an event pertaining to an asset (GRAI) as it moves through the supply chain – from birth (ADD) through midlife (OBSERVE) to death (DELETE)
- **Aggregation Event:** Describes an event pertaining to the physical aggregation of a child to a parent, such as goods with an asset (i.g. SSCC with GRAI). It is possible to include add an aggregation (ADD), see an aggregation (OBSERVE), or remove an aggregation (DELETE). It is also possible to express any number of aggregation levels (e.g. SSCCs level 1 to SSCC level 2 to GRAI, etc)
- **Transaction Event:** Describes the definitive association or disassociation of an event with a Business Transaction. It is possible to include a hierarchy in a Transaction Event (e.g.: goods 1-3 (SSCCs) with pallet 1 (GRAI) correspond to the Purchase Order N°B-4567, etc)
- **Quantity Event:** Describes events pertaining to products without serialized codes. These events include Product Class (e.g.: asset type for the GRAI without serial number), Quantity, Business Location and Time. These events can be used for capturing shipping, receiving or inventory data (e.g.: one hour ago there were 10 pallets in stock's store Y or yesterday warehouse's stock A shipped 22 pallets to location B)



Currently, two models are available to recover EPCIS events:

- The company knows the EPCIS Repository address of the partner that has the information required:
  - **Push:** the partner pushes the event as soon as it occurs
  - **Request/Response:** request the data from the partner and receive it directly from its EPCIS Repository
  - **Subscribe:** Subscribe to some kind of data list from the EPCIS Repository of the partner and automatically receive the data when events occur
  
- Company does not know the EPCIS Repository of the partner that has the information required:
  - **Follow the chain:** ask a partner known who knows the address of the desired partner's EPCIS Repository that contains the information required. Receive the address of the EPCIS Repository and request it the data
  - **ONS:** look up mechanisms to bootstrap the supply chain. Find the EPCIS Repository of the source which is the company that encodes the EPC (e.g. GRAI or SSCC). ONS can be for example use by the company which is the asset final destination in order to retrieve the EPCIS repository of the pool operator and push a Quantity Event about the number of empties available for collection

In the future, another model named Discovery Service will be available. This third mechanism will permit companies to find the address of any partner's EPCIS Repository in the supply chain that has information about a specific product (e.g. a GRAI or a SSCC). Details about this future solution are available from the BRIDGE WP2 & WP3 (<http://www.bridge-project.eu/index.php/Work%20Packages/en/>).

## 8.2 Organizational changes

Asset Management improvement will trigger changes in every company organization especially because improvements depend on a proper use of solutions by a maximum number of partners in the supply chain. Of course, these organizational changes will be more prominent in companies where no current procedure exists for Asset Management. However, because new identification systems such as RFID and new solutions for data exchanges are being employed, changes will undoubtedly occur in every company in the supply chain.

## 8.2.1 Changes specific to the pooling model

In this model, the Asset Management is carried out by the pool operator who needs maximum visibility on assets which circulate in the supply chain.

### 8.2.1.1 For the pool operator

The Pool Operator needs visibility on:

- **Asset location:** Code, quantity and location of the assets in the supply chain
- **Empty stock level:** Code, quantity of empties available at each Pool Operator location
- **Customer demand:** Type, quantity of asset and location of delivery
- **Empties delivery status:** Code, quantity of asset, location and time of the delivery
- **Empties collection:** Code, quantity and location of empties for collection process
- **Asset reconditioning:** Code, quantity and location of asset in recondition process and identification of the responsibilities of the problems occur on the asset

In order to acquire this information, new procedures must be integrated either into the Pool Operation organization or its subcontractors:

- **Asset codification:** The Pool Operator will be responsible for the codification of its assets. Therefore, it has to manage the GRAI creation for all the different assets among the different locations where tagging process will take place
- **Asset tagging:** The Pool Operator can buy pre-tagged asset from a supplier tag them itself during internal processes such as reconditioning. In this case, it will have to establish appropriate tagging procedures for this process that respect the recommendations and standards defined by GS1 –EPC (such as the type, number and location of tags per assets)
- **Asset sorting:** If only part of the asset pool is tagged with RFID tags (or GS1 128 barcode), or if tagged assets are exchanged with only part of the customer, procedures that allow tagged assets to be sorted accordingly must take place during internal processes in order to dissociate the stock
- **Asset identification during inbound/outbound:** In order to know which asset has been delivered to which customer and which asset has been collected from which location, identification procedures must be defined during delivery and collection processes
- **Asset identification during collection and reconditioning:** In order to identify the cause of problem such as damages or loss, asset identification procedures have to be put in place during the collection and reconditioning processes
- **Inventory of the stock:** Stock inventory procedures have to be established in order to prevent out of stock and improve the reactivity to customer demand

In order to obtain visibility on its assets final destination and the amount of time an asset stayed at a customer location, the Pool Operator has to established new work rules with its customers. They must be defined by the kind of information needed (GRAI, quantity, location, disposition, etc) and also the means of data exchange (EDI messages, EPCIS events or both).

In order to improve collection process, Pool Operators must also establish procedures for data exchange with final destination companies who are most often not Pool Operator customers. The new procedures must define the type of data needed and the means of data exchange.

### 8.2.1.2 For the pool operator's customer

The Pool Operator's customer needs visibility on:

- **Empties delivery:** Code, quantity of assets, location and date of the pool operator's delivery
- **Empty stock level:** Type, quantity of empties available in the stock
- **Aggregation information:** Which goods have been loaded onto which asset in order to track and trace the goods in tracking and tracing the asset
- **Asset (and so goods) shipment:** Code, quantity of asset (and so goods), location and time of the shipment

In order to get this information, new procedures have to take place at Pool Operator's customer location:

- **Asset sorting:** As for the Pool Operator, if only one part of the assets used are tagged with RFID tags (or GS1 128 barcodes), or if tagged assets are exchanged only with some of the trading partners, procedures that allow tagged assets to be sorted from the other must take place during internal processes in order to dissociate the stock
- **Asset identification during inbound/outbound movements:** In order to know which asset has been delivered from the pool operator and which asset has been shipped from which location, delivery and collection identification procedures must be defined
- **Inventory of stock:** Stock inventory procedures must be established in order to prevent out of stock and manage resupply or collection of empties from the Pool Operator
- **Aggregation during preparation/picking:** Procedures to associate the code of goods loaded onto the asset (i.e. SSCC or SGTIN and other data) and the code of the asset itself must be established during the preparation process in order to achieve Supply Chain Management

In order to give visibility to the Pool Operator for empty collection, Pool Operator's customer have to transmit information regarding the amount of time the assets stayed at its location and the final destination of its shipment. The new procedure has to define what, when and how data should be exchanged with the Pool Operator in respect to GS1-EPC standards and recommendations.

In order to grant its partner the possibility to achieve Supply Chain Management through Asset Management, the Pool Operator's customer has to transmit the aggregation of information about goods and asset association. This could be done by pushing a DESADV EDI message or an EPCIS Aggregation event.

In order to grant other trading partners the possibility to track and trace goods by tracking and tracing assets, the pool operator's customer must also generate and publish an Aggregation Event in its EPCIS Repository.

### 8.2.1.3 For the final destination of assets

The Final destination of assets needs visibility on:

- **Empty stock level:** Code, quantity of empties available for collection
- **Empties collection:** Location and date of empty collection

In order to get this information, new procedures have to take place at the final location:

- **Asset sorting:** If only part of all the assets received are tagged with RFID tag (or GS1 128 barcodes), certain procedures that allow tagged assets to be sorted from the other must take place during internal processes in order to dissociate the stock
- **Inventory of stock:** Stock inventory procedures must be established in order to manage the collection of empties with the Pool Operator
- **Asset identification during collection:** In order to know which asset has been collected by which pool operator from which location and at what time, collection identification procedures must be defined

In order to give visibility to the Pool Operator for empty collection, final destination companies have to transmit information about quantity and location of empties. The new procedure will to define what, when and how this data will be exchanged the Pool Operator.

## 8.2.2 Changes specific to the exchange model

In this model, each trading partner is responsible for the Asset Management. Each company's IT system manages its partner's accounts with information about the type, quantity, quality and location of the exchanged assets.

### 8.2.2.1 For the trading partners:

The Trading partners need visibility on:

- **Empties delivery:** Code, quantity of assets, location and date of the pool provider's delivery

- **Empty stock level:** Type, quantity of empties available in stock
- **Aggregation information:** Which goods have been loaded onto which asset in order to track and trace the goods by tracking and tracing the asset
- **Asset (and so goods) shipment:** Code, quantity of asset (and so goods), location and time of the shipment
- **Empties collection:** Code, quantity and location of empties for collection process

In order to get this information new procedures must take place:

- **Asset sorting:** If only one part of the assets in stock are tagged with RFID tags (or GS1 128 barcodes), or if tagged assets are exchanged with only some of the trading partners, procedures that allow tagged assets to be sorted from the others must take place during internal processes in order to dissociate the stock
- **Asset identification during inbound/outbound:** In order to know which asset has been delivered by the pool provider and which asset has been shipped from which location, delivery and collection identification procedures must be defined
- **Inventory of stock:** Stock inventory procedures must be established in order to prevent out of stock and manage resupply from pool provider or collection of empties from trading partners
- **Aggregation during preparation/picking:** Procedures to associate between the code of goods loaded onto the asset (i.e. SSCC or SGTIN and other data) and the code of the asset itself must be established during the preparation process in order to achieve Supply Chain Management

In order to balance asset partner accounts, companies need to have visibility on their partner's empties stock. Therefore, they have to establish new rules for data exchange with their partners: what, when and how data will be exchanged in respect with GS1-EPC standards and recommendations.

In order to grant its partners the possibility to achieve Supply Chain Management through Asset Management, companies have to transmit the aggregation of information concerning goods and asset association. This could be done by pushing a DESADV EDI message or an EPCIS Aggregation event.

### 8.2.2.2 For the pool provider

The Pool Provider needs visibility on:

- **Empty stock level:** Code, quantity of empties available at each pool provider location
- **Customer demand:** Type, quantity of asset and location of delivery
- **Empties collection:** Code, quantity and location of empties for collection process
- **Asset reconditioning:** Code, quantity and location of asset in recondition process and identification of the responsibilities of the problems occur on the asset

In order to obtain this information, new procedures must be put in place either in the Pool Provider organization or its subcontractors:

- **Asset codification:** The Pool Provider will be responsible for asset codification. Therefore, it has to manage the GRAI encoding for all the different assets among the different locations where the tagging process will take place
- **Asset tagging:** The Pool Provider can buy pre-tagged asset from a supplier or can tag itself its assets during internal processes such as reconditioning. In this case, it will have to establish tagging procedures for this process that respect the recommendations and standards defined by GS1 –EPC (such as the type, number and location of tags per assets)
- **Asset sorting:** If only one part of the assets in the pool are tagged with RFID tags (or GS1 128 barcodes), or if tagged assets are exchanged with only some of the customer, procedures that allow tagged assets to be sorted from other must take place during internal processes in order to dissociate the stock
- **Asset identification during inbound/outbound:** In order to know which asset has been delivered to which company and which asset has been collected from which location, delivery and collection identification procedures must be defined
- **Asset identification during collection and reconditioning:** In order to identify the causes of problems such as damages or loss, asset identification procedures must take place during the collection and reconditioning processes

- **Inventory of the stock:** Stock inventory procedures must be established in order to prevent out of stock and improve the reactivity to customer demand

In order to have visibility on the collection location of the assets, the Pool Provider must establish new work rules with companies. Together, they must define the kind of information needed (GRAI, quantity, location, disposition, etc) and also the means of data exchange (EDI messages, EPCIS events or both).

## 9 Implementation road map

Apart from the Discovery Service, all the standards and components for the mentioned GS1-EPC Asset Management solutions already exist today: GRAI, SSCC, GS1 128 barcode, EPC Gen2 tag and reader, RFID middleware, EDI messages, EPCIS Events and ONS. Some companies have already begun to implement them in order to improve their Asset Management and their Supply Chain Management. For example, in order to improve its fresh produce logistic, the retailer Delhaize launched the project entitled “DC Fresh 2” to increase its traceability from pallet level to crate level. By September 2009, new model of plastic crates will be delivered to the fresh food manufacturers of Delhaize. Identified by a GRAI encoded into two GS1 128 barcode and one Gen2 RFID tag, this new crate will be identified with either barcode or RFID readers by the trading partners at each step of the logistic process. During the delivery of empties, Delhaize will identify which crate is shipped to which manufacturer. This will allow them to efficiently manage manufacturer crate accounts, have more visibility on crate uses and simplify the identification of problem starters such as damages or loss. During the preparation process, the manufacturers will associate in their IT system the goods with the crates they are loaded on. This will give the possibility to track and trace the goods by tracking and tracing the assets. Then, during the shipment, the manufacturer will identify the crates and send Delhaize an EDI message (called DESADV) which will provide the details of the shipping unit loaded into the truck. The information exchanged is, for example the list of the GRAI, list of the products loaded into the crates, final destination of each crates, etc. Finally, thanks to the DESADV, during receiving process, Delhaize will control and validate the shipment by identifying the crates and will sort the goods automatically in preparation for store delivery.

The Delhaize project is not a fluke; in the past couple of years we have seen more and more examples of these solutions being implemented throughout the European Retail Sector. These share two common tendencies. The first focuses especially on Asset Management. The implementation concerns specific assets of a high value for which companies need the smallest pool size, the less amount of damages and asset loss as possible. This kind of implementation occurs most often in the automotive, aeronautic or other specific activity sectors which need specific and expensive assets. A great example of this tendency comes from Airbus which uses RFID tag to identify its Jiggs, the big assets used to transport part of a plane (see <http://www.rfidjournal.com/article/print/4036>). The second tendency is more focused on Supply Chain Management than on Asset Management. Companies implement solutions to track and trace their goods by tracking and tracing the asset they are loaded on. This kind of implementation specifically concerns the industry sectors where time to market is an important factor, such as Fruits and vegetable, Meat or Fish (see the example of Schuitema <http://www.rfidjournal.com/article/articleview/3793/1/1/>) as well as sectors where goods are expensive and where there is a risk of shrinkage and theft such as electronics sector (mobile phone, TV, DVD, video games, etc).

Whatever the tendency companies follow, the implementations that have already emerged in the market have one point in common. All of them have a defined perimeter, a defined number of assets and a defined number of partners involved. Controlling the system is the key to a successful implementation and use. Trading partners could easily collaborate on how to implement these solutions and how to work alongside one another. However, the supply chain is not a closed system but an open loop world. Therefore, since the decision has been made to use new work methods using new solutions, there is a strong need for standards for this implementation to be successful. For example, companies need to define

the location of the tags (or the barcodes) fixed to the asset in order to avoid different tagging from one partner to another which can lead to reading problems. They also need to define what kind of data should be exchanged with partners in order to avoid different demands for information from different partners and so limit specific software development. This is exactly the GS1 and EPCglobal's role, to define recommendations for implementation of standardized solutions in an open loop system.

Thanks to the work of the BRIDGE WP9, GS1/EPC decided to launch the Returnable Transport Item Pallet Tagging Working Group in 2009 (RTI PT WG) in order to draw up a recommendation for pallet tagging. This working group included all the major players of the pallet world: pool providers, pool operators and end-users. Their recommendation fix these main elements:

- Minimum of two pieces of RFID tags should be placed on a pallet in order to assure a minimum process security
- Wooden pallets should have one RFID tag on the longer side and one tag on the shorter side of the pallet
- Plastic pallets should have one RFID tag in the corner and another RFID tag in the opposite corner of the pallet
- All the tags fixed onto a pallet have to encode the same GRAI (one and its duplication)

Other working groups will be launched by GS1-EPC since companies in the supply chain need a common recommendation for implementation. In the near future, the same work done with pallets could be done on crates, rolls, or any other type of asset use in the supply chain.

Although it is always difficult to visualize a road map for new technology implementation, two main phases seems to occur. The first phase is directly linked to what we have just explained above. It is the standardization recommendation and market maturity phase. This first step consists of finalizing the standardization work which encompasses the asset tagging and also the integration of new exchange data model into the companies such as new EDI messages or EPCIS events. Thanks to these standards and recommendations the pool operators and pool providers will progressively tag their pools in a standardized way. This work could be done by waiting for each asset to return for reconditioning or by buying pre-tagged assets to replace those destroyed or lost. Currently, there are already some actors that offer a full RFID asset, such as Smart Flow Pooling ([www.smartflowpooling.com](http://www.smartflowpooling.com)) or Euro Pool System in Europe or iGPS in USA ([www.igps.net](http://www.igps.net)) and ambitious programs have been launched by other assets pooler such as EPAL, who wants to tag its entire pallet pool by 2012 (see <http://www.gs1.eu/index.php?article=30&show=34>). This phase will also give pool players an opportunity to find how the solutions can improve their own processes, develop a new methodology of work and measure the economic impact associated. Finally, it will allow them to define which new services they will offer to customers in order to improve their competitiveness. For the other actors in the supply chain, such as the end-users, this step will also permit progressive solution deployment. Companies need to improve their experience level and prepare the deployment by launching RFID pilots with partners in order to deploy RFID readers, implement new EDI messages and EPC capture/exchange infrastructure in their information systems. They also need this step to analyse the costs and benefits associated with the use of these solutions in order to define a strategy for implementation.

The second phase begins when the standards are available and when companies have enough experience with new solutions to implement. Within this phase, companies will begin to deploy step by step. First they will only involve certain actors in specific sectors of the supplier chain where Asset Management and Supply Chain Management require improvement. Secondly, they will gradually open the perimeter of implementation with new partners, new sectors and also new assets. Finally, when a subsequent number of companies use the solutions, the mass market will be achieved and agreements between

companies from an entire sector (i.e. Fruit & Vegetables) have decided to deploy the solution, it will be used in a real open loop system.

## **10 Methodology**

In order to succeed in their implementation, companies have to follow four main steps:

- The Initialization step consists in understanding the current difficulties and imagine how GS1 and EPCglobal standards based solutions can provide opportunities
- The Preliminary study step consists in analyzing in real context if new solutions performed in the specific context of the company. For example, RFID is not a plug and play technology. Electromagnetic phenomenon can impact the performances and need adjustments to give satisfaction. It is different to implement RFID on crates that transport textile products than vegetables (i.e. Absorption phenomenon). This step is also important to define the perimeter for the introduction of the new solutions, evaluate the technical and the organizational impacts for the company, analyze the potential costs and benefits, and sensitive the head office in order to be supported before going ahead
- The Pilot is a mandatory step, moreover when company wants to implement solution based on RFID or EPCIS Events exchanges. Within it company will confront new solutions during further months with the real world in order to improve them, validate the performances obtained and implement gradually with the current system. It will also be useful to evaluate precisely the costs and the benefits of the solutions and define indicators to evaluate continuously the results. At the end, this step validates or not the deployment start
- The Deployment step consists in implementing the solutions step by step by following the plant and measuring the indicators defined during the Pilot in order to validate or correct the differences