Building **R**adio frequency **ID**entification for the **G**lobal **E**nvironment

Returnable Transport Items: Requirements to improve Reusable Asset Management

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About the BRIDGE Project:

BRIDGE (**B**uilding **R**adio frequency **ID**entification 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.

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This document:

This document provides a first description of business requirements for RTI management. It will be completed by learning of pilot phases of WP9. It describes the basic requirements in terms of functionality, technology and change management. Based on the survey made for the first report, the scope of this document is limited to pooling and exchange models for pallets and crates. It covers the larger RTI market. It was necessary to limit the scope to be able to provide a limited number of requirements. This approach will provide a good way to work on business cases and to give a practical example of what needs to be done for RTI management. Some specific requirements exist for other RTIs but mainly in close loop applications where exchanged information are limited.

Disclaimer:

This document results from work being done in the framework of the BRIDGE project. It does not represent an official deliverable formally approved by the European Commission.

Introduction

This document provides a first description of business requirements for RTI management. It will be completed by learning of pilot phases of WP9. It describes the basic requirements in terms of functionality, technology and change management. Based on the survey made for the first report[1], the scope of this document is limited to pooling and exchange models for pallets and crates. It covers the larger RTI market. It was necessary to limit the scope to be able to provide a limited number of requirements. This approach will provide a good way to work on business cases and to give a practical example of what needs to be done for RTI management. Some specific requirements exist for other RTIs but mainly in close loop applications where exchanged information are limited.

[1] In the document 9.1, 52% of company which responded to the survey own their RTIs and use the exchange model, and 34% rent their RTI. 60% are using pallets and 15% are using crates. Pallets and crates are the most popular RTIs.

1 Acknowledgements

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2 Background

The current document follows deliverable D9.1 “Returnable Transport Items: the market for EPCglobal applications”. In the latter, the scope of the document was to identify the market in quantitative and qualitative terms and to define the opportunities for EPCglobal applications, RFID and EPC network.
For the pooling model, weaknesses described in the first document enlighten issues for pool operator to locate empty RTIs to collect its. Pool operator would like to have more visibility (get information about movement of RTIs) to be able to anticipate demands. More visibility is also an opportunity to reduce costs.
For the exchange model, the main issue is to keep record of any exchange to be able to know the balance of RTIs for each partner. This issue could be solved if a large number of company implement a RTI management solution. Such solution should be easy to adopt because a lot of SMEs are doing ecxhange.

In the current document, work package 9 project team defines the requirements for the solutions that will be specified in phase 3 and pilot in phase 4.

3 Requirements

3.1 Domain

The project will study the requirements and solutions for the pooling and the exchange models.

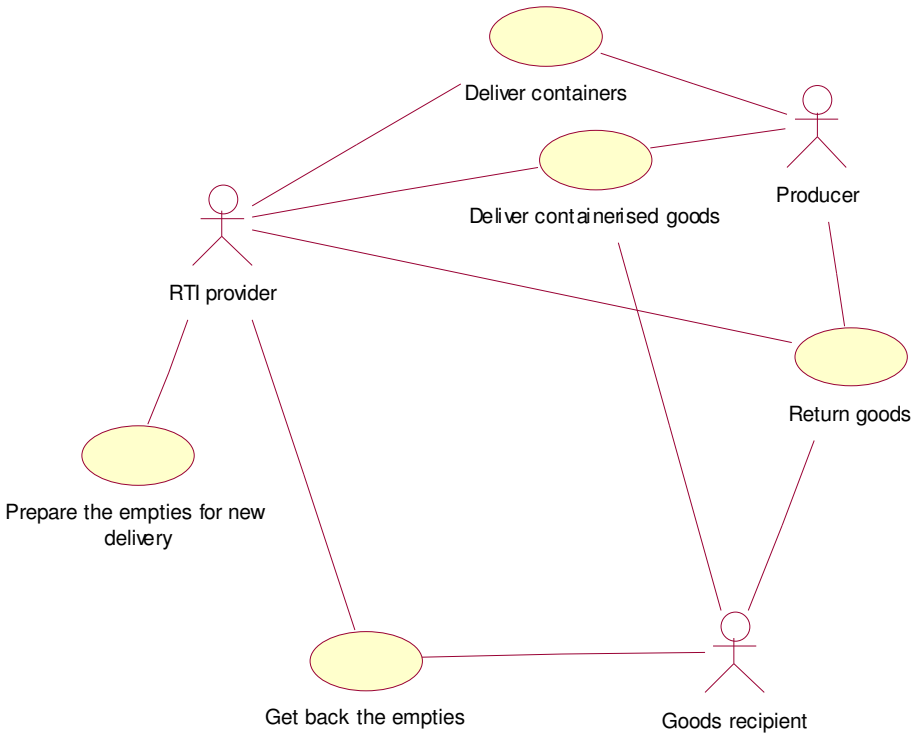
The project will focus on pallets and crates.

The project will address mainly the food and beverage sectors.

The project will focus on the supply chain aspects of the models, that is to say information that is shared by partners.

For the pooling system, the requirements will therefore address the following use cases:
- Deliver containers
- Deliver containerised goods
- Return goods
- Get back the empties

These use cases are described in the deliverable 9.1. During each step, RTIs movement should be declared to pool operator.



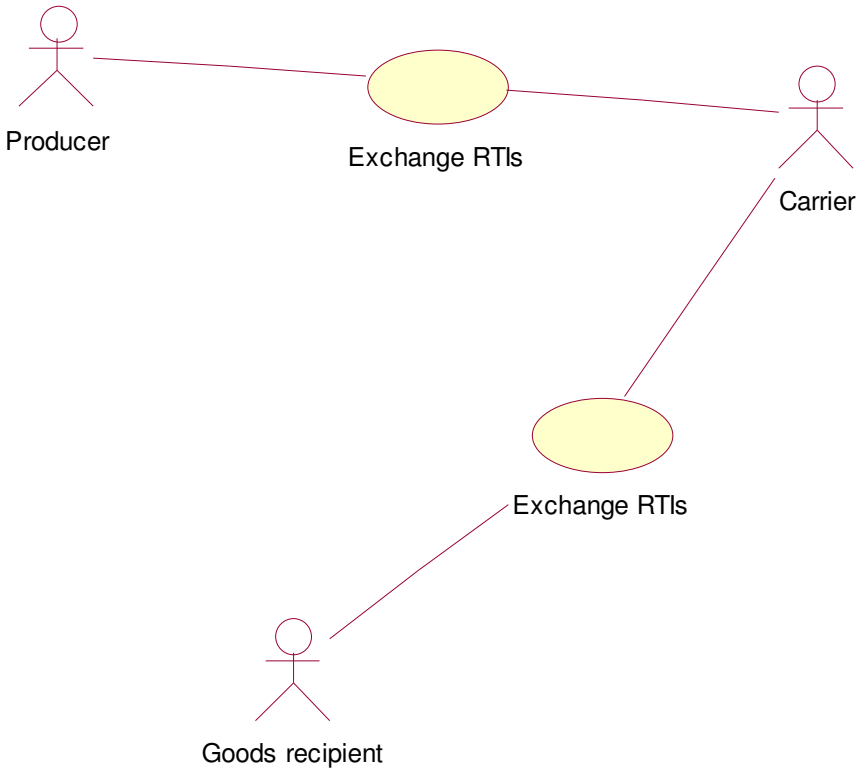
Pooling model use case diagram

“Prepare the empties for new delivery” is excluded of the business requirements.

For the exchange model, the requirement gathering will include:

- Exchange RTIs between Producer and Carrier
- Exchange RTIs between Carrier and Goods recipient

the information that should be exchanged is exactly the same if there are other company involved in the supply chain. For example, if there is another carrier between the first carrier and the goods recipient, the exchange of information between the two carriers will be done in the same way as any other exchange. In point of fact, each time a RTI is transfer between two companies, there is an exchange. The first company should record that the second one need to get back the number of exchanged RTIs and the second one should record the same information.



Exchange model use case diagram

3.2 Objectives

The system that Bridge WP9 will be set up is a traceability system that will enable to locate RTIs and/or to have a better knowledge of inventories.

The requirement gathering phase will:

- Identify requirements for RTI identification
- List requirements for data capture
- Specify requirements for data exchange.

Functional and technical requirements are in the scope.

Change management requirements will be identified as well.

3.3 Context

The project is conducted in the context the **European Regulation (EC) N. 1935/ 2004** on material and articles in contact with food obliges companies to trace materials that are in contact with food. Crates and their constitutive materials fall in this category. The regulation is applicable since 26th October 2006.

Work in the project is conducted under the standard umbrella of the EPCglobal working groups and especially the RTI working group. It means that the goal of WP9 is not to define standards but to implement available standards and to provide input to standard definition if there are some adjustment to do to fulfil business requirements.

3.4 Functional requirements

3.4.1 Data

1.1.1.1 Identification of RTIs

The recommended standard to identify a returnable asset is the GRAI, Global Returnable Asset Identifier. In the EPC world and for the pooling model, the serial number must be used, in order to identify each different asset.

The GRAI structure is defined below:

Asset Identification Number		Serial number (optional)
GS1 Company Prefix → ← Asset type	Check digit	
0 N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 N_9 N_{10} N_{11} N_{12}	N_1	**X_1 -- variable X_{16}**

The maximum length of the GRAI is 30 digits.

In the exchange model, there is a need to have a unique number to be able to detect the RTI. From a supply chain perspective, the need is to identify a type of RTI and there is no need for a serial number. The existing French codes for RTIs could be used providing that knowledge of the codes is spread among trading partners and maintenance process is visible. See Annex A for the current list (available in French only).

1.1.1.2 Identification - allocation rules

The GRAI is allocated by the owner of the RTI.

For exchanged RTI, there is a specific issue to address. Such RTI could be produced and owned by several parties. To simplify the solution, it should be useful to have a single asset identification number (as defined in France by GS1) but each producer should be able to allocate a unique serial number for this single asset identification number. The market should address this issue. One way could be to discuss with the organisation in charge of EURO pallet specification to add specific rules for the allocation of GRAI.

If the tag is pulled out in the course of reconditioning, a new GRAI is allocated by the owner of the RTI.

Replacement of parts of the RTI for repair does not imply change to the GRAI.

1.1.1.3 Links between RTI identification and other identifications (e.g. SSCC)

The GRAI should to be associated with the SSCC. The SSCC is not mandatory and is short – term life, i. e. as long as the RTI is loaded with goods.

3 possible solutions are anticipated:

- The SSCC is encoded in the RTI tag. There is a need for a writtable tag since the SSCC is encoded after the GRAI. When the unit load is unpacked, a process to delete the SSCC is required.
- The SSCC is encoded in the tag that is embedded in the paper label that also carries the SSCC in GS1128 and human readable formats. The GRAI and the SSCC are read are read in the same session and associated in the IT system. There can only be one SSCC per unit load.
- The SSCC is not tagged on the logistics unit but is stored in a system and is transmitted through data exchange. When reading the GRAIs from the tag, the SSCC is retrieved form the IT system. It implies that the GRAIs have been transmitted in the messages prior to the receipt process takes place.

This topic is really important when RTI identification number is used to track and trace contents. For traceability, the SSCC is necessary to record and to archive goods informations.

1.1.1.4 Movements – events

The IT system will store and share information about movements of RTIs.

A movement is defined as any event that affects the stock either in a quantitative or in a qualitative way.

In the pooling model, required information on the event/movement are:

- The GRAI number including the serial number;
- The date/ time;
- The identification of the location where the event took place by means of a GLN;
- Description of the type of location;
- The type of event being captured.

In the exchange model, required information on the event/movement are:

- The type of RTI (Asset identifier number)
- Quantity of the type of RTI
- Date of the movement
- Identification of partners.

3.4.2 Description of transactions between actors and their links to the data models

Information about events shall be made available. There is no need to exchange master data.

In the pooling model, the types of events that are traced are:

- Sent from RTI provider
- Received at producer (from the RTI provider and from the distribution centre when RTI returned)
- Sent from producer
- Received at distribution centre
- Sent from distribution centre
- Received at delivery location
- Sent from delivery location
- Received at packaging centre
- Received at RTI provider

In the exchange model, the types of events to be traced are:

- Sent from producer
- Received by goods recipient
- Received by carrier
- Delivered by carrier

The event information is provided by the party that generates the event. For example, the "sent from producer" event information is provided by the producer. Events and their originators are listed in the table below:

Events to be traced and the parties that generate them Pooling model	
Event	**Generated by**
RTI sent by RTI provider to producer	RTI provider
RTI received at producer	Producer
RTI sent by producer	Producer
RTI received at distribution centre	Distribution centre
RTI sent from distribution centre	Distribution centre
RTI received at delivery location	Delivery location
RTI sent from delivery location	Delivery location
RTI received at packaging centre	Packaging centre
RTI received at RTI provider	RTI provider

Another event is needed: destroyed. It is needed to end the life cycle of the RTI. This event can be generated by any of the parties listed above.

Events to be traced and the parties that generate them Exchange model	
Event	**Generated by**
RTI sent by producer	Producer
RTI received at distribution centre	Distribution centre
RTI received by carrier	Carrier
RTI delivered by carrier	Carrier

3.4.3 Query

Depending on the model and on the process, different query could be done on the network. The following criteria could be used :

- List of GRAI number
- List of Asset Identification number
- Location
- Period of time

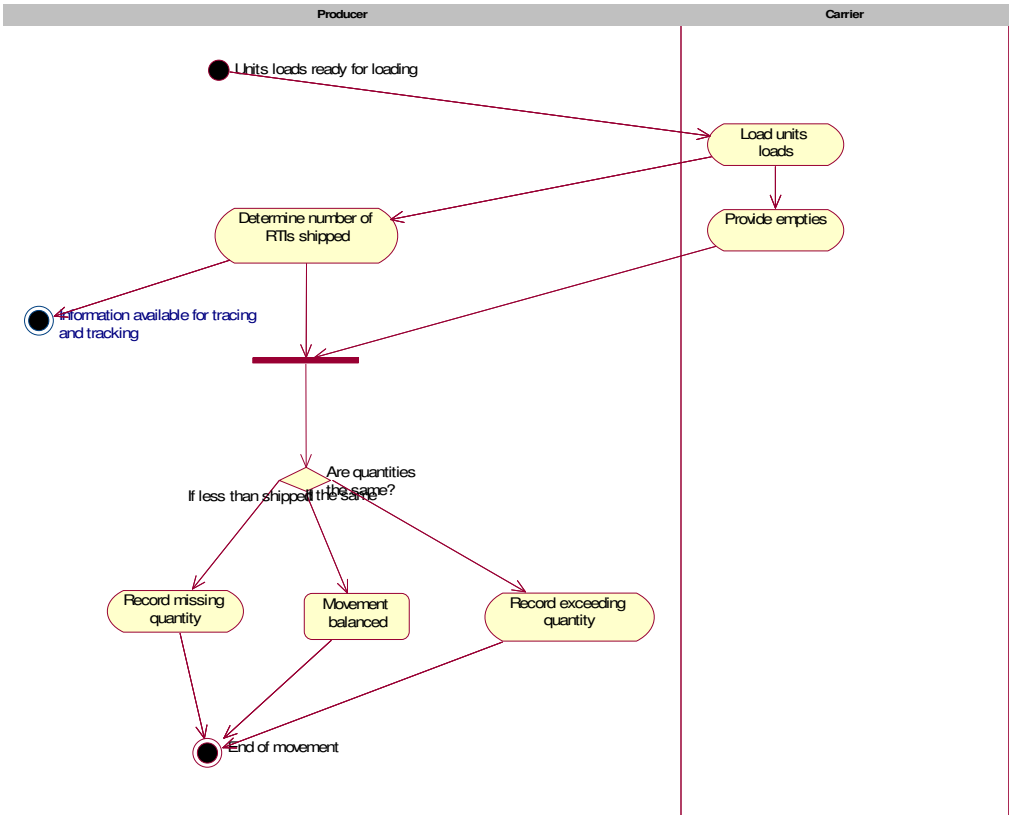
For the two models, the most common query are :
Pooling model :

- Where are empties RTI (based on asset identification number) ?
- What is the full history of detections of RTI item 123?
- What is the quantity of RTI in a specific location ?
- What is the turnover of RTI in a specific location ?

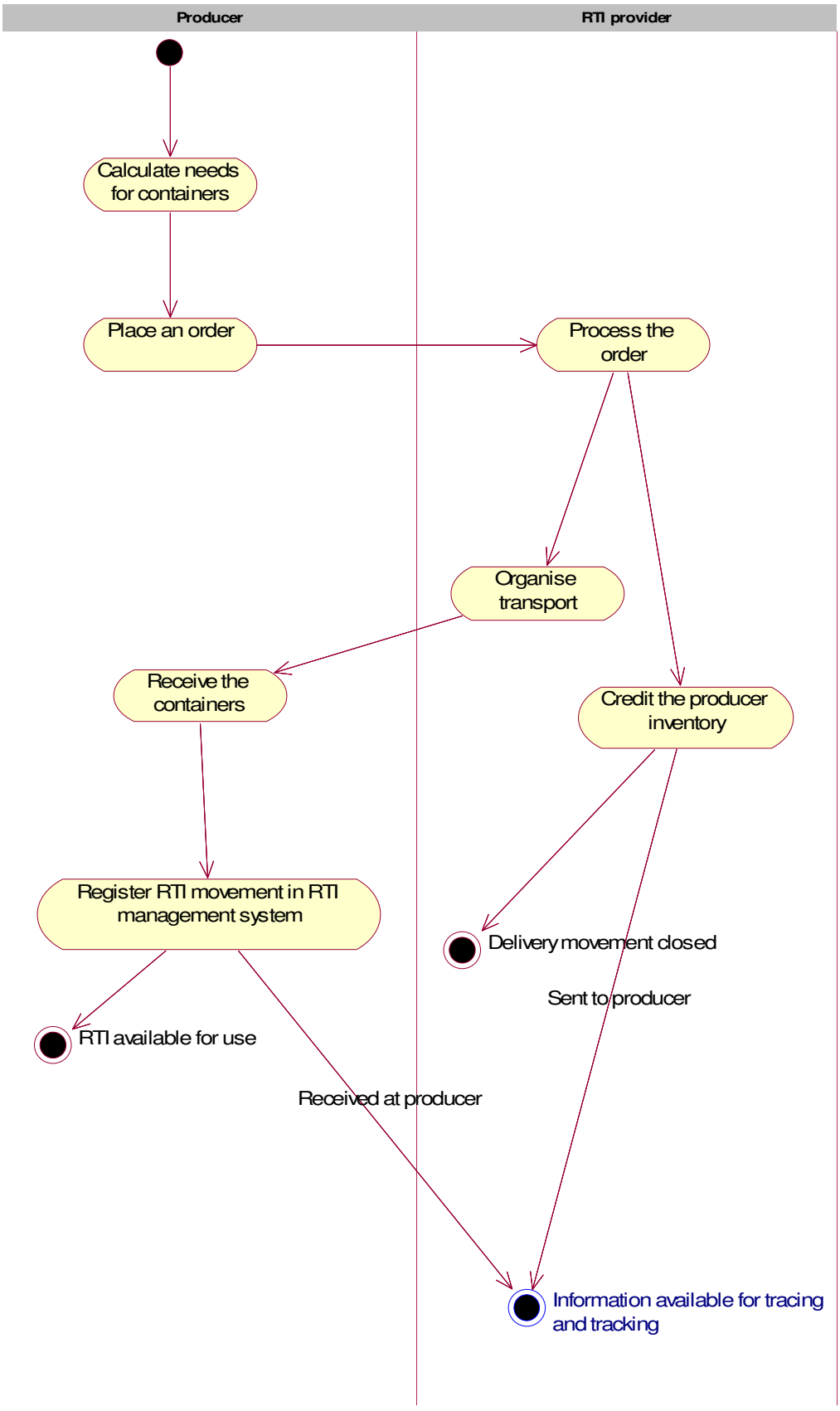
Exchange model :

- What is the quantity of RTI exchanged with a specific location for a period of time?

Sequence diagram: Exchange RTIs between producer and carrier



Sequence diagram : Deliver containers



the events will provide critical information to manage RTI in pooling and exchange model.

Pooling model: events will provide visibility to pool operator to invoice customer. There will be used to locate empties RTI to be able to pick up empties RTI. There will be useful to deliver empties RTI to customers depending on RTI use. There could be used also to identify location where there is some losses.

Exchange model: events will provide capacity to each partner to know exactly what is the quantity of RTI due to other partners. It will provide an easy way to detect any disagreement on exchanged quantity.

The way to use events for RTI management will be described in the Business Case description (document 9.3).

3.5 Technical requirements

3.5.1 Volumes (number and frequency of transactions)

As defined in 3.4.2, the following table shows the minimum number of events per originator:

Party	**Number of movements / year**
RTI provider	2 x number of RTI x number of movements per RTI per year
Producer	2 x number of RTIs used per year
Distribution centre	2 x number of RTIs used per year
Delivery location	2 x number of RTIs used per year
Packaging centre	1 x number of RTIs used per year
Carrier	2 x number of RTIs used per year

Number of RTIs = Number of reusable pallets + number of reusable half pallets + number of reusable quarter pallets + number of reusable crates.

Events could be stored during many years depending on traceability and legal requirements.

3.5.2 Architecture

Information should be available in three different ways:

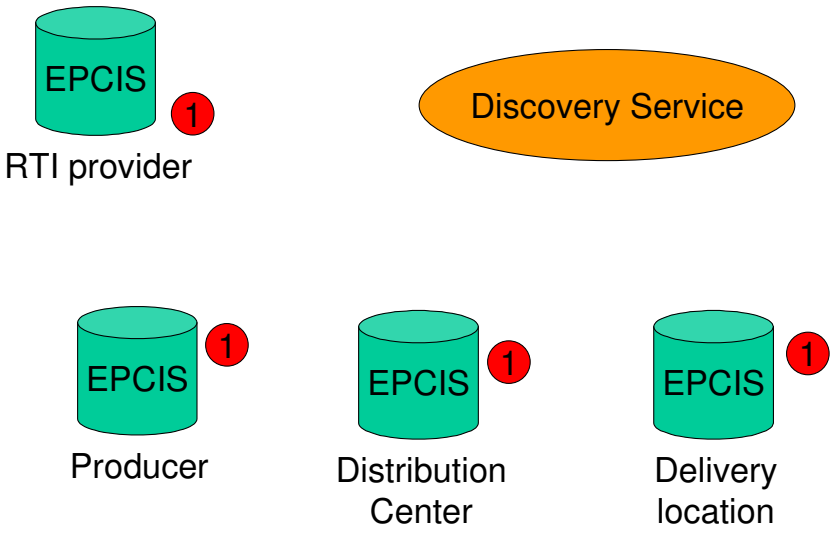
- In the EPC network configuration using EPC IS and discovery services;
- Using EDI messages in a peer-to-peer configuration. Information is pushed to the recipient.
- Use of an EPC IS with Edi messages should be investigated.

Whatever the system chosen, shared data should be compatible with existing applications, such as the use of the Eancom® message INVRPT. See annex B for the French implementation guideline of the message (only available in French).

Architecture solution will be based on BRIDGE technical work package conclusions. WP2 and WP3 will provide the discovery service specification, WP4 will provide security infrastructure to identify each partner and to secure data exchange. EPCIS specifications will be provided by EPCglobal. A software will be used to manage RTI based on information get from the network. This software could be one solution of the market or will be developed for the pilot.

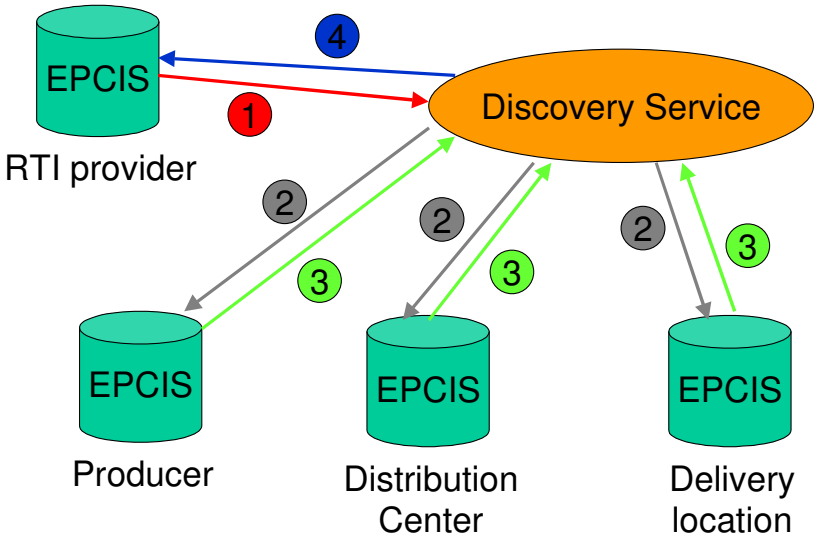
For the pooling model, the EPC network could be used by all the actor to publish any information regarding movements of RTIs. Then, pool operator will have the capacity to get information about location of RTIs and to know exactly what are the use of RTIs for each company. With these informations, pool operator will be able to deliver empties RTIs at the right place, at the right time and in the right quantity.

Architecture for pooling model : step 1, publication of informations



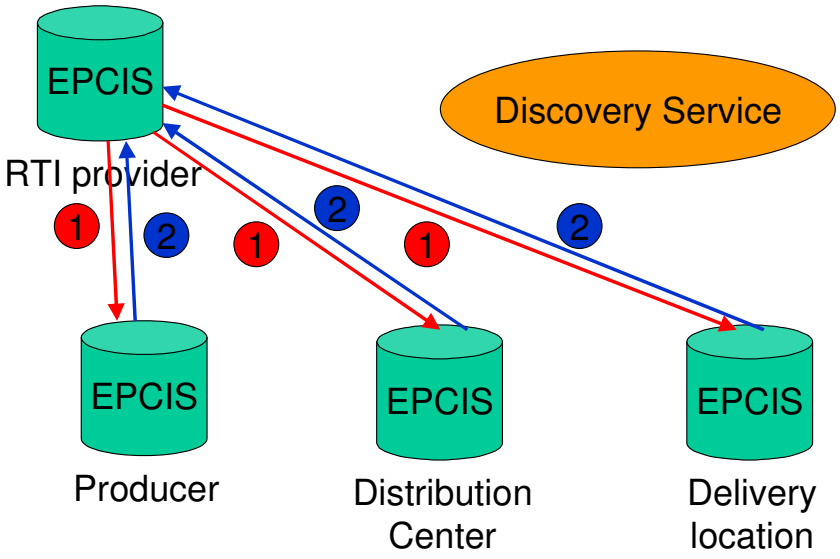
1	Each partner publishes information about movement of RTIs

Architecture for pooling model : step2, search of information by pool operator



1	Pool operator sends a query to Discovery Service
2	Discovery Service sends the query to EPCISs
3	EPCISs respond to the DS to declare valid information for the query
4	Discovery Service provides the list of EPCIS which have valid information for the query

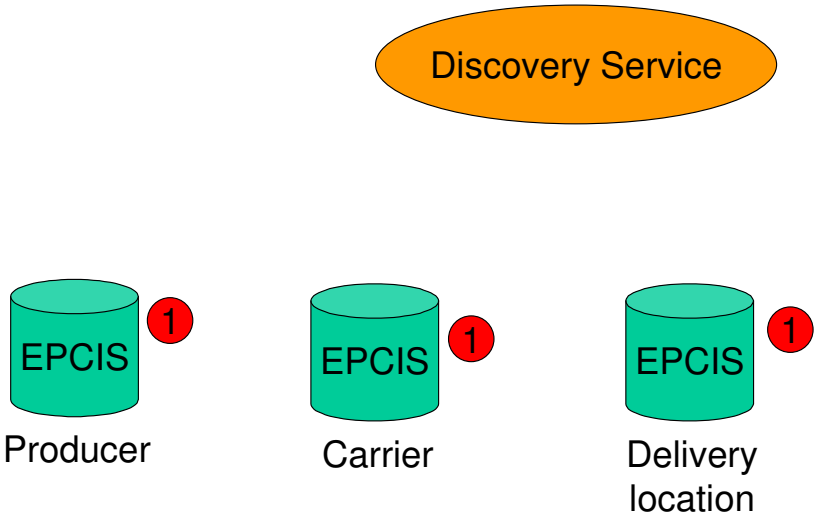
Architecture for pooling model : step 3, collect information from the different EPCISs



1	Pool operator sends the query to each pertinent EPCISs
2	EPCISs respond to the query by sending valid information to the EPCIS of the pool operator

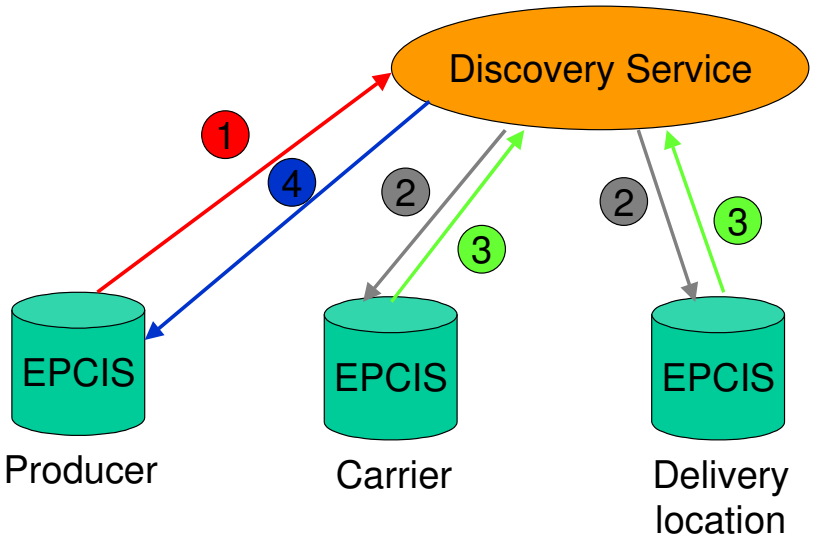
For the exchange model, the EPC network could be used by all the actor to publish any information regarding movements of RTIs. Then, each actore will have the capacity to get information about movement of RTIs. With these informations, they will be able to update and control balance of RTIs. It could be used also by third party to manage balance of RTIs for its clients.

Architecture for exchange model : step 1, publication of informations



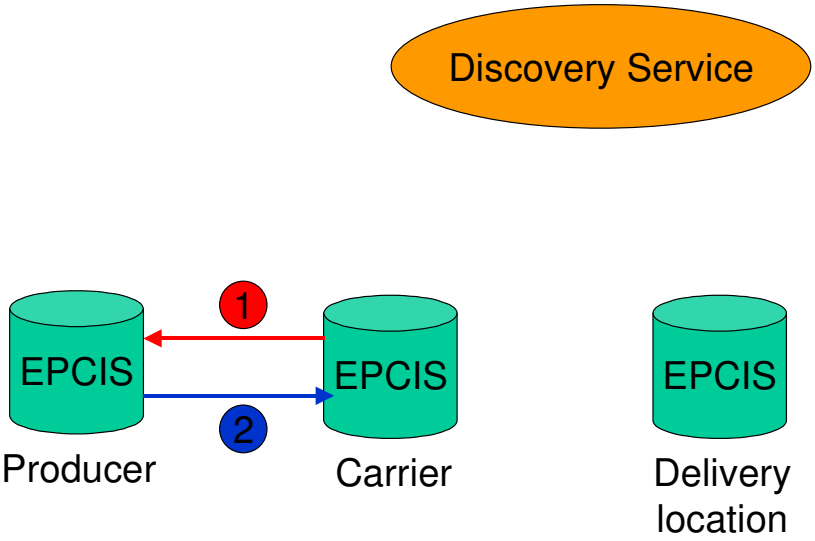
1	Each partner publishes information about movement of RTIs

Architecture for exchange model : step2, search of information by one partner



1	The producer sends a query to Discovery Service
2	Discovery Service sends the query to EPCISs
3	EPCISs respond to the DS to declare valid information for the query
4	Discovery Service provides the list of EPCIS which have valid information for the query

Architecture for exchange model : step 3, collect information from the different EPCISs



1	Producer sends the query to each pertinent EPCISs
2	EPCISs respond to the query by sending valid information to the EPCIS of the producer

3.5.3 Transaction, server and Tag security

If the RTI Tag only contains the GRAI of the RTI (see section 1.1.1.3) the information is freely accessible to all partners. If the SSCC is encoded in the RTI tag, once the unit load is unpacked, the SSCC must be deleted.
Security solutions will be based on BRIDGE WP4 recommendations.

3.5.4 Software functionality

This paragraph provides a list of functionality that were identified as useful for the different actors. This list will be completed during the next stages (9.3 and 9.4) if necessary.
Description of functionality is done for the two models. Of course, lot of company are using both. It means that software should be able to support the different functionnality of the two models.
These functionality could be implemented by each partner or could be provided by third party.

1.1.1.5 Pooling model

Pool operator: Currently, each pool operator has its own software to manage its activity. Regarding the opportunity to have more information by using the EPC network, it could be necessary to improve this software. The following functionality could be added or updated:

- RTI pool management: with RFID, it will be easy to have a description of each RTI based on its GRAI number
- Maintenance management: for each RTI it should be possible to record any information regarding quality and maintenance process. It is possible to detect any RTI that should be washed or controlled.
- Customer services: stock management in all customer location should be managed to plan replenishment
- Empty RTIs management: with visibility on stock in final destination, it should be possible to plan empty RTIs picking
- Customer services invoicing: depending on contract, RTI movement information are used to invoice customers.

Pool operator customer (producer, distribution center,…): the pooling model is based on a minimum of actions that need to be done by customers. Customers should only provide information to pool operator regarding use of RTIs. However it could be useful for customer to be able to manage RTIs:

- RTIs availability: with information collected by RFID, it should be possible to know exactly the availability of RTIs. Alert could be done based on minimum of stock.
- Invoice control: depending on the contract, information regarding RTIs use and turnover should be available to control invoice.

Other actor (not in contract with pool operator): usually, other actors in the supply chain don't have any contract with pool operator. They don't have to manage such RTIs. However it could have an agreement between these actor and the pool operator to provide information about quantity of empty RTIs available on different location. This information will help the pool operator to pick empty RTIs in an efficient way.

- Empty RTIs management : the stock of empty RTIs should be managed to be able to provide information to pool operator to pick empty RTIs.

1.1.1.6 Exchange model

In this model each partner have to managed its own pool of RTIs. Functionnality are the same for all partners:

- RTI pool management: information regarding asset type and quantity should be managed. It should be also possible to manage level of stock to have alert and plan replenishment
- Partner information: for each partner, it should be possible to manage RTIs balance
- Regularization process: if there is no capacity from one partner to provide the right quantity of RTI to balance the RTI account, it should be possible to send an invoice to adjust the balance.

3.5.5 Data capture

1.1.1.7 RFID tags requirements

The system should conform to the Air interface Class 1 Gen 2 standard which operate on UHF frequencies (860-960 MHz). RFID chips need 96 memory bits available.

The Tags should be able to cope with the conditions of the RTI life cycle:

- Resist repainting;
- Resist manual and mechanised handling
- Resist washing (high pressure, high temperatures and detergents);
- Out-door storage and transportation.

The tags duration should fit the longevity of the RTI. A life period of 15 years appears as a minimum for tags applicable to pallets and crates.

The tags should be able to cope with the unit load storage conditions:

- Very low temperature (-40°C) for tags applied on deep-frozen goods and ice-creams;
- Low temperature for tags applied on fresh products.

Tags should be located within the RTIs in order to protect them from trauma. In case the tags are embedded in a (wooden or a plastic) component of the RTIs, visual indications of their placement are recommanded in order to allow manual reads.

Tags should be positioned in a way that they are not removed when parts of the RTIs are changed. For example, tags on crates with bale arms should not be on the arms. It is generally recognized that a pallet tag should be located on the central foot.

As Food and beverage sector often use configurations of RTIs with water content, 100% of read rate is difficult to achieve with one tag per RTI. The double tagging represent a strong option to guarantee the performance of the technology, specially for crates. In this option, each tag will be uniquely identified but will use the same GRAI for RTI identification. This option will also provide a back-up solution in case of a tag failure.

There is no identified need for sensor enabled tags for crates and pallets.

3.5.6 RFID readers

The use of forklift, portal and manual readers should be reliable to identify a single RTI. For multiple reads operations, portal and manual readers are solutions to be privileged.

Taking into account, the technology already available, two axis of improvement are identified:

- Readers synchronisation : up to 30 readers should cohabit in a same warehouse
- Anti-collision : pallets of empty crates could contains 300 units which represents 600 tags to read in a row in case of double tagging.

In all cases, the readers should be able to cope with the warehouse characteristics when relevant:

- Low and very low temperatures
- Static electricity for consumer electronics
- High rate of humidity

.

The reader infrastructure should also be interoperable with read shipping units or read multiple cases operation.

3.5.7 Migration from existing systems to new systems

Need to keep compatibility with existing standards (e.g. Invrpt developed in France)

Define a migration policy including proprietary applications.
This topic will be developed during the pilot phase.

3.5.8 System performances

Information about the event should be available **one hour** after the event occurred.
The system must be available 7 days a week and 24 hours a day minus maintenance.
Maintenance times should be coordinated to limit disruption of the service.
The system should provide replies to a query within one hour.
The system should be able to cope with season and daily activity picks

3.5.9 Exception cases - backup

The use of a non-RFID backup (bar code and readable information) is recommended for exception situation, in case of single tagging.

3.6 Change management requirements

3.6.1 Training

Logistic operator : Training should be done to facilitate adoption of RFID technology by end users. A training on RTI management process could be necessary if this is a new process for end users. Any modification of current RTI management process will require specific training.

IT people : to facilitate implementation of new technology like RFID and to understand the RTI management process It should be necessary to provide training to IT people. This document and the first WP9 deliverable could be used.

3.6.2 Documentation

Several document could be useful to implement EPCglobal standards for RTI management :

Internal implementation:

- RTI management introduction
- RTI management procedures

Communication to partner:

- RTI management introduction (exchange and pooling model)
- RTI management : best practice document
- Introduction to EPCglobal standards for RTI management

Solution providers:

- D9.2 Returnable Transport Items: business requirements

3.6.3 Impacts on existing organisations

Depending on context, impacts on existing organisations should be analysed :

- Social : is there any impact on labour, RF consequences on human body, …
- IT : modification of current software, security, integrity,…
- Logistic process : modification of workstation, added or removed actions,…
- Relationship with logistic partners : RTI responsibility, legal responsibility, cost of RTI management,…

Regarding the current reality of RTI management, It could be necessary to understand the impact of a good RTI management on the second-hand market. In some countries, this market is mainly based on the fact that company will not have good RTI management process.

3.6.4 Performance tests

Standard for applied RTIs tags performance is required. Two major scenarios need to be addressed in priority:

- Portal reading of a single pallet or crate
- Portal reading of multiples crates on a pallet

This standard will permit to verify that RFID tags in situation will provide a satisfying level of performance.
Some added performance tests scenario could be necessary when RFID tags on RTI are used to track and trace products inside. These scenario will depend from one company to an other.