GS1 Germany

The Global Language of Business

GS1 Standards

EPC-based RFID Item Level Tagging

Implementation Guideline for Companies of the Apparel, Fashion and Footwear sector

Guideline

Document Summary

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Document Description	This document aims at providing a comprehensive best practice guideline for implementing and maintaining successful RFID item level tagging in the Apparel, Fashion and Footwear industry. Version 1.1 addresses specifics of the shoe sector regarding RFID item level tagging. For this purpose, the guideline was extended with chapter 6, which not only accommodates guidance on relevant footwear specific matters, but also allows for extensibility for future sector-specific amendments.

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Disclaimer

GS1 Germany at a glance

GS1 Germany supports companies from all sectors in the adoption and practical implementation of modern communication and process standards in order to improve the efficiency of their business processes. Within Germany, the company is responsible for the maintenance and continued development of the GS1 article identification system GTIN (Global Trade Item Number) for globally unique identification, which in turn serves as the basis for bar codes. Moreover, GS1 Germany supports the application of new technologies for the fully automatic object identification (EPC/RFID – Electronic Product Code/Radio Frequency Identification) and standardised electronic data interchange (EDI). GS1 also offers customer oriented solutions (ECR – Efficient Consumer Response) as well as the consideration of trends such as mobile commerce, multi-channeling as well as sustainability within development work.

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1 Introduction

1.1 Mission

EPC-based RFID Item Level Tagging (ILT) enables organisations to leverage a huge variety of use cases aiming at **increasing efficiency**, opening **new business opportunities** as well as **improving transparency**. Amongst other things, it especially provides a fast and accurate way to track and trace goods as well as manage inventory throughout the supply chain and at the Point of Sale (POS).

This document provides a **best practice guideline** in order to manage RFID ILT implementations in an international environment. The purpose of this guideline is to help the respective stakeholders along the supply chain to comply with GS1 standards as well as to handle all processes concerned with RFID item level tagging in an efficient manner.

Currently, the following **trends** can be observed in the apparel, fashion and footwear (AFF) sector:

- adoption of RFID ILT is gaining momentum
- more and more RFID pilots are leading to roll-outs
- ILT is used in more and more product categories

That being said, there is an increasing number of manufacturers, suppliers and solution providers which is involved in ILT-related processes (e.g., a manufacturer which is requested to attach RFID tags to the products by a brand owner placing an order). However, this is leading to a growing number of divergent adoption variants which impairs the overall efficiency and causes additional costs. For instance, RFID tags are placed at different positions, follow deviating encoding procedures and have varying backup approaches. Especially in supply chains of the AFF industry, which oftentimes are characterised by several hundred or thousand business partners, this is becoming a serious issue.

Thus, there is a strong need among end user companies and solution providers to **have a common understanding** and **alignment of ILT-related processes** in order to **reduce complexity** as well as **costs** along the entire value chain. In the same context, it is required to define the contents of an **EPC RFID ILT training program** enabling companies to **certify** that they have the know-how to manage **standard-compliant RFID item level tagging**.

1.2 Scope

1.2.1 In scope

This guideline supplements the GS1 standards by offering best practice solution approaches for the following subjects:

- **EPC Management** (including serial number management and exception handling)
- **Tag** and **Tagging** (including tag placement, general advise as to tag performance, and SGTIN back-up)
- **Quality Assurance** (e.g., as to verification of the encoding process, applying tags, and maintaining high tag readability)

Thereby, this guideline explicitly deals with one-way (i.e. not reusable) RFID tags.

The **audience** of this document is **stakeholders** (see chapter 1.3) **dealing with ILT processes**, i.e. organisations of the **AFF sector** involved in the handling of AFF products, which assign serialised identifiers at product item level (or intend to do so) while using inexpensive, low-capacity EPC RFID tags.

Apart from that, this document shall serve as a **conceptual basis for future user training material** aiming at putting this guideline into execution in practice.

1.2.2 Out of scope

This guideline will not address:

- solution approaches for business requirements from **sectors other than AFF** (though several approaches most likely will be transferable)
- technical specifications for **RFID tag performance** (for this purpose, please refer to the corresponding surveys/guidelines, see references)
- specifications for **business messages** of any kind
- specifications for the **encoding** of **barcodes/RFID tags** (for this purpose, please refer to the EPC Tag Data Standard and the GS1 General Specifications)
- **recommendations** as to **hardware/software solutions** and **vendors**
- **basic information on RFID** technology (frequencies, functional principle, ...)
- **EPC Data Sharing**
- **layout** and **print quality** of **labels**
- procedures for reusable **RFID hard tags**
- descriptions of specific **use cases** such as RFID-based counterfeit protection

In terms of usability, this guideline will refer to other relevant documents rather than unnecessarily duplicate their contents whenever it is appropriate.

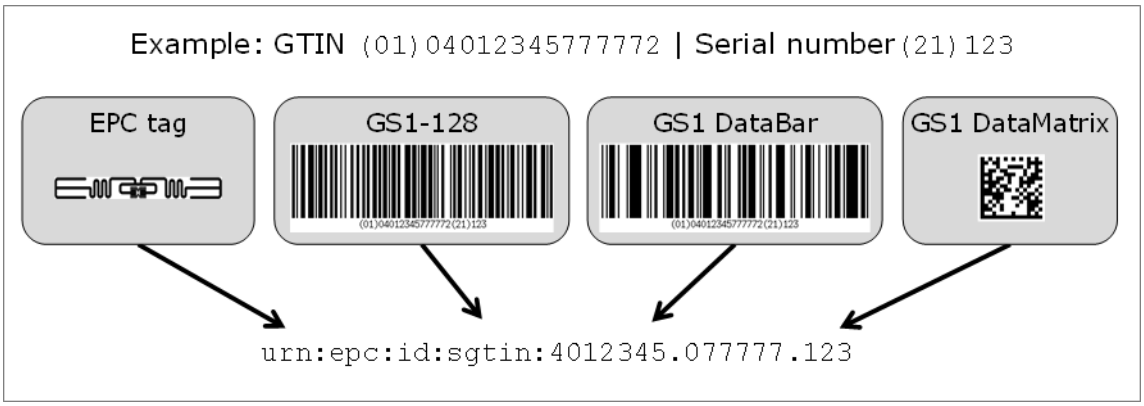
1.3 Stakeholders

The following table contains a brief description of the stakeholders involved. Thereby, it should be noted that a company can represent different roles. For instance, there is a growing number of retailers which have established private brands and thus can be considered as brand owner, producer and retailer at the same time. On the other hand, there are also suppliers which have set up their own retail stores and which operate their own warehouses and thus can simultaneously be seen as brand owner, producer, retailer and solution provider. This is why the roles are to be interpreted in a functional way (i.e., producer function, retailer function, freight forwarder function, etc.).

Term	Definition
Agency	The party responsible for organising the sourcing, quality assurance and other connected services on behalf of the brand owner.
Brand Owner	The party that is responsible for allocating GS1 System Identification Keys. The administrator of a GS1 Company Prefix. [GenSpec 2015, 475] In the AFF sector, the brand owner oftentimes corresponds with the term 'supplier'.
Freight Forwarder	The party that arranges the carriage of goods including connected services and/or associated formalities on behalf of the shipper (consignor) or consignee. [GenSpec 2015, 477]
Logistics Service Provider	Party providing logistic services such as warehousing, re-packing products, distribution and assembly. Synonym: Third-party logistics provider (3PL) [GS1 LIM 2007, 84]
Producer	The party that produces, provides, or furnishes an item or service. In the AFF sector, the producer oftentimes corresponds with the term 'manufacturer' and/or 'vendor'.
Retailer	The party that sells directly to the consumer. [GDD GDSN]
Solution Provider	An organisation that develops and implements systems for end users that are based on or implement the GS1 system of standards in its various business processes. [GDD GS1 Architecture] In the context of this document, a solution provider is for instance a service bureau printing and/or encoding tags.

1.4 Basics as to EPC and RFID

It is vital to comprehend that **'EPC'** and **'RFID'** are **no synonymous terms** at all. An **Electronic Product Code** is a **universal identifier** for a given physical or digital object (a product, a shipment, a document, etc.). It is used in information systems that need to track or otherwise refer to these objects. **RFID** on the other hand is just a **data carrier** that is able to convey an EPC. However, an EPC can also be derived from appropriate 1d/2d codes (such as a GS1 DataBar or a GS1 DataMatrix). The latter is illustrated in the following figure.



As this guideline is specifically concerned with RFID item level tagging, we consider an 'EPC tag' to be an RFID tag that complies with the GS1 EPC Tag Data Standard.

2 EPC Management

In a nutshell, this paragraph paves the way for a successful and effective EPC management. Thereby, it explains the major challenges, describes general serialisation strategies, and gives advice for the most common scenarios in which organisations have to assign serial numbers.

2.1 General remarks

The **owner of the GS1 Company Prefix (GCP)** bears the **overall responsibility for EPC management**. This is usually the brand owner. A proper EPC management is of utmost importance for the overall success of RFID ILT. Above all, it must be ensured that:

(a) there are **never any overlapping (i.e. double) EPCs**,

(b) the encoding procedure is **compliant with** the **GS1 EPC Tag Data Standard**, and

(c) the **length of the GCP** (which is always an inherent element of any EPC) is correct.

As to (a), it is key that a combination consisting of a GTIN and a serial number is assigned only once. Otherwise, data inconsistencies are pre-programmed.

Item (b) is based on the fact that all supply chain partners trust that each and every RFID tag can be read and interpreted according to the procedures described in the respective GS1 standards.

Last but not least, item (c) is referring to the issue that the length of the GS1 company prefix can vary between 6 and 12 digits. Thus, its value has to be known before the encoding procedure. Otherwise, information systems would be unable to filter/query for items of a specific brand owner or identify the respective items in the first place.

The following table provides two examples of how a GTIN (one with a GCP length of 7, the other with a GCP length of 9 digits) along with a serial number is converted into an SGTIN (Serialised Global Trade Item Number) EPC. Thereby, the EPC URI represents the format which, e.g., is used in EPCIS, whereas the EPC binary code would be encoded onto an EPC transponder (the depicted binary code was created based on the presumption of using low-capacity EPC tags encoding an SGTIN destined for retail POS).

For further details as to the correspondence between GS1 keys and EPCs or the encoding procedure, please refer to the Tag Data Standard, section 7 and 14, respectively.

GTIN + serial number	GCP length	EPC URI	EPC binary code (hexadecimal)
04012345123456 + 9999	7	urn:epc:id:sgtin:4012345.012345.9999	3034F4E4E40C0E400000270F
05391505378882 + 321	9	urn:epc:id:sgtin:539150537.0888.321	302E022C8C90DE0000000141

Legend:

Indicator Digit: the leftmost digit of a GTIN-14. In the case of GTIN-12 or GTIN-13, a zero pad character takes the place of the Indicator Digit and is usually applicable for all apparel/fashion products. While '9' is reserved to identify variable measure trade items, '1' to '8' may be used to define trade item groupings.

GS1 Company Prefix: a unique string of variable length, allocated by a GS1 Member Organisation, to issue GS1 identification keys (e.g. GTINs).

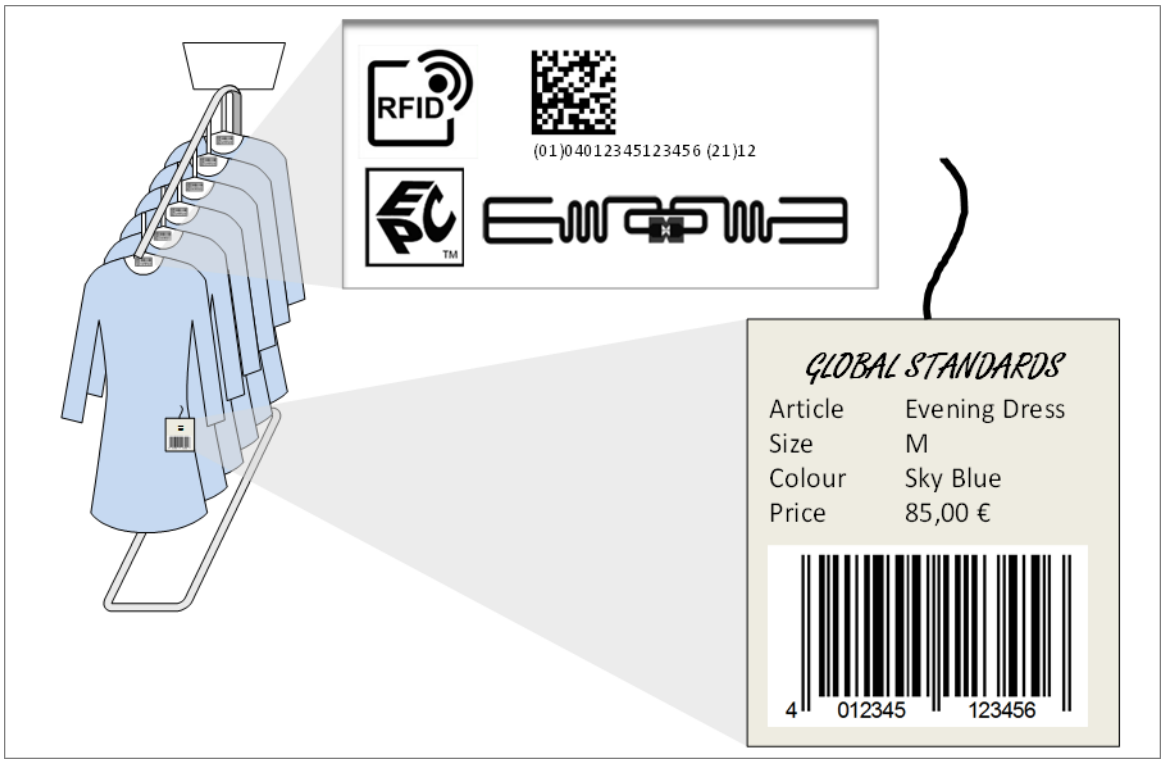
Item Reference: a number allocated by a user company to identify a trade item varying in length as a function of the GCP's length.

Check Digit: a mod-10 algorithm digit that is used to check whether the number has been correctly composed.

Serial Number: a code assigned to an individual instance of an entity for its lifetime.

The serial number is generally written in decimal for purposes of human-readable representation, for encoding into barcodes, in EDI and EPCIS messages. The binary equivalent only occurs in the RFID tag itself, and in certain low-level software that interfaces directly to RFID readers and printers.

Apart from the items mentioned above, it is of vital importance that there is a congruent identification of an item of concern. For instance, the EPC (e.g. the **SGTIN**) which is stored on the EPC tag **has to be consistent** with any GS1-based product identification applied elsewhere on that very item (e.g., the price label containing the **GTIN** encoded in an EAN-13/UPC-A barcode, see the following figure). Note: if organisations make use of proprietary product identification schemes, the latter has to be mapped to a proper GTIN.



It should be noted that even though the GS1 General Specifications define a serial number as an alphanumeric string of 1 to 20 characters, a low-capacity RFID tag only allows for 1 to 12 digits, where the **serial number** does **not** have a **leading '0'** and is less than or equal to 274,877,906,943 (274 billion+ instances). For details, please refer to the TDS, section 6.3.1.

2.2 IT-based vs. chip-based serialisation

In general, two approaches can be distinguished for serial number management: an **"IT-based"** and a **"chip-based"** serial number management. The IT-based approach relies on information systems managing the allocation of serial numbers. In contrast to that, the chip-based approach makes use of a hardware feature of RFID tags, the so-called Tag Identifier (TID) – a memory bank on RFID tags which – along with some descriptive information about the RFID chip – often includes a serial number assigned by the chip manufacturer.

Due to some technical reasons and to diminish the overall complexity in supply networks of the AFF sector, this guideline advocates using the **IT-based serialisation approach**. The following chapters will break down the IT-based approach for the most common scenarios. In order to ensure **data security**, all methodologies require organisations to set up appropriate **back-up** solutions.

2.3 Serialisation scenarios

Companies in the AFF sector have developed various strategies for serial number management. The following passages describe best practice approaches for the most common use cases.

Note: while the subsequent descriptions deal with SGTIN EPCs, they are similar to ITIP (Individual Trade Item Piece) EPCs as introduced in section 6.

2.3.1 Tagging finished goods based on sequential serialisation

This approach makes sense especially for (a) organisations with just one production line/plant manufacturing the entire production volume of a given GTIN or (b) solution providers (i.e. service bureaus) responsible for encoding all RFID tags for a given GTIN. In both cases, the brand owner usually entrusts a **solution provider** with the **serialisation management**. Thus, the serialisation mechanism is typically provided by this very solution provider, e.g. as part of the software controlling the RFID tag printer.

In this simple scenario, the only requirement is a counter allocating serial numbers one at a time, i.e. the first instance of a product receives serial number 1, the second receives serial number 2, and so on. In the case of a sequential serialisation, the software needs only keep track of a single number, i.e. the next available serial number in the sequence. This is critical information to ensure that serial numbers are not duplicated.

Note that **serial numbers only have to be unique within a given GTIN**. Thus, if there are multiple GTINs (i.e. multiple products), there is a "next number" for each GTIN and the serial number assignment database keeps track of the next available serial number for each of the respective GTINs.

GTIN	Serial number	Example
04012345123456	1	urn:epc:id:sgtin:4012345.012345.1
	2	urn:epc:id:sgtin:4012345.012345.2
	…	…
05391505378882	1	urn:epc:id:sgtin:539150537.0888.1
	2	urn:epc:id:sgtin:539150537.0888.2
…	…	…

2.3.2 Tagging finished goods based on static allocation of serial number ranges

A static allocation of serial number ranges is applicable when products sharing the same GTIN are manufactured and/or tagged by more than one supply chain partner. This includes having several manufacturing lines within the same plant, manufacturing lines that are geographically distributed, or third parties providing value added services. In this case, the challenge is to ensure that one supply chain partner does not use the same serial number that a different entity has already used for the same product.

Here, the **serialisation management** should be accomplished by the **brand owner**. To this end, the brand owner does not require specific software. In fact, a **spreadsheet** (with an adequate backup) is sufficient. Based on this record, RFID tag printers at the manufacturing lines/plants are provided **separate sets of serial numbers to use within each GTIN**. In that way, a portion or the entire range of possible **serial numbers for a GTIN** is **divided into blocks**. Each block is then assigned one manufacturing line/plant.

Going for this approach usually only requires the brand owner a one-time configuration in the software controlling the RFID tag printer or a communication with the respective solution provider which has to configure the specified serial number ranges on behalf of the brand owner.

One option consists in constructing the serial number in pieces. For instance, each production line or manufacturing plant could be assigned a **static** one-, two- or three-digit code that prefixes a

continuous number. In conjunction, both would build up to the actual serial number. In the example indicated beneath, a specific production line or plant would only be permitted to generate serial numbers beginning with a predefined prefix (in this case, '10' or '11'):

Production line/plant	Line/plant code	Example
Plant A, line 1	10	urn:epc:id:sgtin:4012345.012345.101235
Plant A, line 2	11	urn:epc:id:sgtin:4012345.012345.1198765
Plant B (one line)	12	urn:epc:id:sgtin:4012345.012345.124
…	…	…

As an alternative to the above depicted method, companies assign **continuous ranges** of serial numbers to the respective units. In such a scenario, a production line/plant is given a predefined range of serial numbers. Within this range (for instance, 200000 to 399999) it is free to assign any serial number unless it does not exceed the specified lower and upper limit. A continuous range allocation table would look like this:

Production line/plant	Minimum serial number	Maximum serial number
Plant A, line 1	1	199999
Plant A, line 2	200000	399999
Plant B (one line)	400000	599999
…	…	…

All in all, this approach (in its different variants) is rather straightforward to apply, especially as there is no special software required. Organisations basically just need to maintain a record of what ranges/prefixes have been allocated to which production line/plant. However, it requires careful planning (e.g., as to the number of production lines/plants for a given GTIN, the likely volume, etc. both now and in the future).

2.3.3 Tagging finished goods based on dynamic allocation of serial number ranges

A dynamic allocation of serial number ranges allows overcoming the disadvantages of a static allocation indicated in the previous chapter. In this case, serial numbers are allocated on a **demand-driven** basis, rather than in advance. This requires a software solution which assigns serial numbers in response to requests.

To this end, a brand owner typically has to deploy a **serial number range server** providing a network-based application programming interface (**API**) through which supply chain partners can request a block of serial numbers: First, a production line/plant issues a request (containing the required number of serial numbers for a specified GTIN). Second, the serial number range server allocates a corresponding block of hitherto unused serial numbers. Third, the server responds by electronically providing these numbers (either by listing them or by indicating the lower and upper limit). In a simplified manner, the following table illustrates the basic functional principle:

Production line/plant	Query	Response
Plant A, line 1	"I (GLN 0123456789104) require 1000 serial numbers for GTIN 04012345123456."	"You can use serial number range 1-1000 for the requested GTIN (04012345123456)."
Plant A, line 2	"I (GLN 0123456789111) require 10000 serial numbers for GTIN 04012345123456."	"You can use serial number range 1001-11000 for the requested GTIN (04012345123456)."

Plant B (one line)	"I (GLN 9876543210913) require 150 serial numbers for GTIN 04012345123456."	"You can use serial number range 11001-11150 for the requested GTIN (04012345123456)."
Plant B (one line)	"I (GLN 9876543210913) require 150 serial numbers for GTIN 04012345123456."	"You can use serial number range 11151-11300 for the requested GTIN (04012345123456)."
Plant B (one line)	"I (GLN 9876543210913) require 2000 serial numbers for GTIN 04012345999990."	"You can use serial number range 1-2000 for the requested GTIN (04012345999990)."
…	…	…

For the time being, there is **no** GS1 **standard** as to the **API** required for a dynamic allocation of serial numbers. There are various commercial proprietary solutions (usually making use of web service technology), which however are akin in terms of their request and response messages. GS1 may come up with a set of standardised business messages for serial number management at a later point of time. The outcome of such a work effort would probably consist of an open web service description which can either be implemented by any end user or which can serve as a blueprint for a standardised serialisation service provided by a third party.

2.3.4 Dealing with non-functional RFID tags

Due to quality issues, poor handling, etc., it can occur that an RFID tag is not working anymore. As soon as an organisation realises such a situation, it is required to create a new EPC tag. In this case, the encoded SGTIN EPC is usually reconstructible as the label containing the corresponding GTIN and serial number (either encoded in a barcode or in plain writing) is still attached to the respective item. Thus, one should proceed as follows:

(a) Take a **blank RFID tag** (usually a hang tag)

(b) Conduct a **teach-in process** (i.e. enter/scan the GTIN and serial number of the item of concern and write the corresponding SGTIN onto the blank RFID tag)

(c) Attach the newly written **tag** to the item (thereby, the old tag does not necessarily have to be removed as it encodes the very same SGTIN)

2.3.5 Tagging existing untagged inventory (online scenario)

A retailer (or any other downstream party) wants to tag its existing (either partly or entirely) untagged inventory. This usually occurs when suppliers have not yet begun/just begun RFID source tagging and the retailer does not want to wait until the inventory is replaced by source-tagged items over time.

If there are **RFID printers present**, one should proceed as follows:

(a) **Request serial numbers/serial number ranges** for each GTIN of the items to be tagged by making use of a serialisation service as outlined in section 2.3.3.

(b) **Print and encode** the resulting **SGTINs** onto the (either hang or adhesive) labels. GTIN and serial number should be encoded in a GS1 DataMatrix with the GS1 Application Identifiers '01' and '21'. (See figure on the right-hand side for orientation purposes).

(c) Attach the encoded tags to the respective items. Thereby, the **GTIN on** the **RFID tag and** on the **price label** have to be **identical**.

If there are **no RFID printers available** (e.g. for reasons of cost-efficiency or if the RFID printer within a store is out of order), one should proceed as follows:

(a) **Scan the EAN-13/UPC-A** (encoding the GTIN) of an item to be tagged

(b) **Request a serial number** for this very GTIN by making use of a serialisation service as outlined in section 2.3.3.

(c) Take a **RFID blank tag** and **scan** it
Remark: the blank RFID tags should be discriminable to enable an RFID device to notify the person conducting the teach-in process in case that there is more than one RFID tag in its read range.

(d) Encode the **RFID blank tag** with the resulting SGTIN

2.3.6 Tagging existing untagged inventory (offline scenario)

If an **online scenario** as described in the previous chapter is **not applicable and RFID printers** are **not available**, organisations can also go for the following procedure.

As a **precondition**, the organisation which wants to conduct tagging of hitherto untagged inventory needs to be provided with **pre-encoded/pre-printed GIAI tags**. Ideally, the GS1 DataMatrix barcode encoding the GIAI (GS1 AI '8004') should be easily removable (e.g., by incorporating a perforation line).

In pre-encoding the blank RFID tags, please note the following: If you are the owner of the GCP, ensure that the serial number portions contained in the individual asset references of the GIAI have not yet been assigned to other products sharing the same GTIN. If you are not the GCP owner, either contact the respective brand owner or use your own GCP. Even though the individual asset reference of a GIAI stored on a low-capacity RFID transponder can vary between 42 and 62 bits (depending on the length of the GCP), there are some **restrictions to be considered** when building the individual asset reference destined to serve as the serial number of an SGTIN: First, the **actual serial number part** must not exceed **38 bits**, i.e. it should have a value **between 1 and 274,877,906,943**. Second, it must consist of **numeric characters only**. Last but not least, it shall have **no leading zeros**.

The actual procedure consists **of the following steps:**

(a) **Scan the EAN-13/UPC-A** (encoding the GTIN) on an item you want to tag

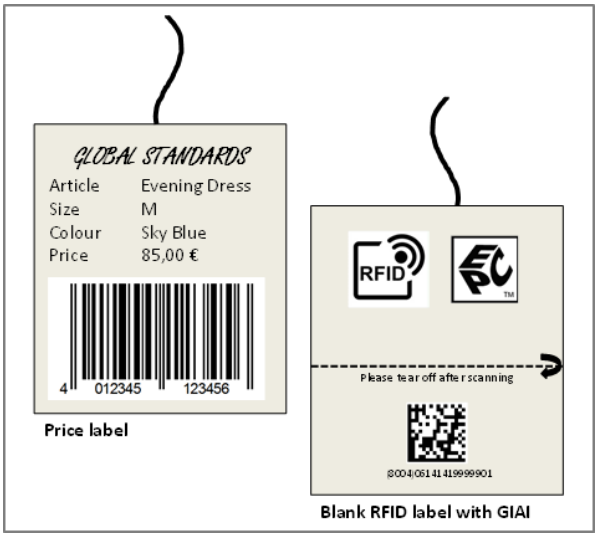
(b) **Take** one of the **pre-encoded RFID tags**, scan its **GS1 DataMatrix code** with the **GIAI** (thereby, the software makes an association)

(c) Attach the RFID tag to the item and **remove** the part of the label depicting the GS1 DataMatrix

(d) **Repeat** steps (a) to (c) **for all** the **remaining items**

(e) **Upload** the **teach-in data**

(f) Take an **RFID reader device, capture** all **GIAI EPCs and replace** them by **SGTIN EPCs** (whereas the last 38 bits of the serial number part persist). This is accomplished in a **bulk operation**. Thereby, a whitelist can ensure that all GIAI EPCs were successfully overwritten by SGTIN EPCs.



As to step (f), the software application in behind should work as follows:

- Take the pre-encoded GIAI, e.g. '`urn:epc:id:giai:4012345.888888`', in binary:
`00110100000101001111010011100100111001000000000000000000000000000000000000000011011001000000111000`
- Query for the associated 14-digit GTIN, e.g. '04012345123456'

- Overwrite header, filter value, partition value, GCP, and item reference (but not the designated 38 bit serial number part) of the GIAI-96, resulting in a proper SGTIN-96, in our case: 'urn:epc:id:sgtin:4012345.012345.888888', in binary:
  00110000001101001111010011100100111001000000110000000111001000000000000000000011011001000000111000

2.3.7 Handling customer returns with intact tags

In this case, the respective item only needs to be added to the inventory.

If a retailer makes use of the "untraceable mode" (available since the publication of the UHF Air interface protocol standard Generation 2/Version 2), it is required to deactivate that function before adding the item to the inventory. (Explanation: The untraceable mode was introduced to address privacy concerns and enables RFID users to diminish an RFID tag's operation range as well as to restrict the identifying information an RFID tag exposes.)

2.3.8 Handling customer returns with non-functional/killed RFID tags

This is quite similar to the case described in chapter 2.3.4. The only difference consists in the supplemental step of adding the respective item to the inventory.

2.3.9 Handling customer returns without any tag (online scenario)

If a customer returns a product with no tags attached to it at all, the first step consists in **discovering** the **belonging GTIN** (in this context, this guideline **strongly recommends** to use the **original GTIN**). This usually can be accomplished by checking the article information indicated on the **receipt** and/or by consulting the **merchandise management system**.

However, there is no efficient way of determining the **original serial number**. Thus, the retailer (or any other downstream party) has to assign a brand-new serial number to the product.

Once the original GTIN is known, an organisation can proceed as described in section 2.3.5.

2.3.10 Handling customer returns without any tag (offline scenario)

If an **online scenario** as described in the previous chapter is **not applicable**, organisations can also go for the following procedure.

As a **precondition**, the entity which wants to conduct an encoding of a brand-new SGTIN needs to be provided with non-colliding serial number ranges by the GCP owner. This e.g. can be accomplished by a static allocation of serial number ranges as described in section 2.3.2.

Having provided the RFID devices (e.g. an RFID handheld or printer) with GTIN-specific serial number ranges for all products on stock, an organisation can proceed as follows:

(a) Take a **blank RFID tag** (usually a hang tag)

(b) **Scan the EAN-13/UPC-A** (encoding the GTIN) on an item which needs to be retagged

(c) Encode the **RFID blank tag** with the SGTIN consisting of the scanned GTIN and a serial number from the local serial number pool

(d) **Attach** the newly written **tag** to the item

2.3.11 Dealing with lost RFID tags

Due to, e.g. handling errors, quality issues and deliberate tearing, RFID tags can be detached from the items they identify. As soon as an organisation realises that a product is missing its RFID tag, it should proceed as described in section 2.3.4 (if GTIN and serial number is still on hand) or 2.3.9 (if GTIN and serial number are lost as well), respectively.

2.4 Dealing with overproduction/underproduction

As it is not easy to predict the exact number of finished products leaving the manufacturing plant in the end, it is common practice that producers are allowed to deliver slightly fewer or more items than actually ordered. This leads to a couple of **potential problems** though. On the one hand, experience indicates that suppliers which had not a sufficient number of **tags just copied** existing ones, which led to **data inconsistencies** as well as to **additional expenses** as the respective objects were not identifiable via RFID. On the other hand, **spare tags** were **(mis)used on the grey market**.

In order to tackle the issue of copying, producers should be provided with a **sufficient number of EPC tags** which exceeds the purchase order quantity. Ideally, it should correspond with the maximum number of items a producer is allowed to supply increased by a safety buffer to compensate for non-functional RFID tags.

In order to eliminate/diminish the risk that genuine tags are misused on the grey market, companies are advised to apply the following procedures: For **seasonal items**, they should demand from their suppliers to **destroy all unused RFID tags**. For **NOS items**, RFID tags should only be destroyed if the serial numbers are dedicated to a specific purchase order as they typically can be used for further purchase orders. In addition to that, a company can also set up an **(internal) authenticity service** to enable sample checks validating whether specific SGTINs were commissioned at all and if they were received in the Distribution Centre.

3 Tag and Tagging

3.1 Basic requirements on an EPC tag

An EPC tag has to fulfil **essential requirements** to be used in the context of this implementation guideline. These basic requirements are both **functional and non-functional**.

From a **functional point of view**, a tag has to be compliant to the Tag Data Standard (TDS), and the UHF Gen 2 Air Interface Protocol Standard. The first defines the Electronic Product Code, and also specifies the memory contents of Gen 2 RFID tags. The second specifies the physical and logical requirements for passive RFID systems operating in the 860 MHz – 960 MHz frequency range.

Thereby, it is recommended to use low-capacity **EPC tags** only. Remark: alternatively, an EPC tag can also comprise a higher bit capacity which would enable the encoding of alphanumeric characters in its serial number part. However, these tags are usually more expensive. What is more, the numbering capacity of low-capacity RFID tags is more than sufficient for the needs of AFF companies.

Further, it is advisable to **refrain from** any usage of the **user memory** bank on RFID tags. Remark: the user memory bank can be used to store additional data (e.g., dimension and weight) about the item an RFID tag is attached to. However, this goes along with time-consuming bilateral agreements, a potentially impaired read performance, higher procurement costs, and the risk of running into process-related issues in case an RFID tag is not working anymore.

From a **non-functional perspective**, it is very important to inform the consumer about the usage of RFID to avoid possible speculation about the violation of the consumer's privacy. Therefore, it is strongly recommended to have an **open communication** about any RFID usage by appropriately marking all areas in which RFID is applied.

For this purpose, the European Commission recommends to use the **signage** specified in ISO/IEC 29160 (depicted on the right-hand side) on every RFID tagged item. Thereby, the minimum size of the ISO RFID emblem shall never go below a size of **5 x 5 mm**.

In addition to that, this guideline strongly recommends incorporating the **EPC logo** as well. While the ISO RFID emblem indicates the presence of an RFID tag, the EPC logo (depicted on the right hand side in its two available versions – monochrome and coloured) provides a clear indication that the RFID tag stores an Electronic Product Code and that the operator complies with the **GS1 Guidelines on EPC for Consumer Products**. The size of the emblem shall be equal to the ISO RFID emblem. Both guideline and logos are accessible under the following URL: https://www.gs1.org/guidelines-epc ('GS1 guidelines on the use of EPC/RFID for consumer products').

So far, there are **no international regulations/recommendations** regarding RFID signage and/or consumer information. Thus, any indication of RFID usage shall be compliant with relevant trading regulations in the respective country/region.

3.2 Tag placement

This chapter aims at achieving the highest possible consistency regarding RFID tag placement. It shall provide a common understanding where/how to apply EPC tags, ease any related training activities, and enhance efficiency (e.g. as it helps to avoid unnecessary costs due to retailer-specific requirements). First, this chapter provides some general guidance on RFID tag/label placement. Afterwards, best practice examples are given for two of the most common product categories. The latter are compliant with the EPC format and symbol placement guideline published by GS1 US.

3.2.1 General advice

Basically, there are three generic RFID tag types that have to be distinguished:

(a) **Applied** tags (e.g. RFID hang/adhesive tags, RFID price tickets)

(b) **Integrated** tags (e.g. sewn-on/pocket RFID labels, combined RFID/care labels)

(c) **Embedded** tags (i.e. literally sewn-in RFID tags and/or RFID tags which cannot be removed by the consumer without damaging the product)

With regard to option (a), organisations should **use existing EAN-13/UPC-A marking or placement standards**. As such, the EPC tag should be **integrated in** or **placed on/adjacent to** the **price ticket**. In general, this is the **preferred way** of mounting an EPC tag.

With regard to option (c), this guideline strongly recommends to **refrain from any embedded tags** (for future projects requiring the embedding of EPC tags, as it is foreseeable e.g. in the shoe sector, see the note in section 6.1.3). This is to prevent organisations to get involved in any privacy issues. In this context, please refer to the **Privacy Impact Assessment (PIA)** framework which helps companies to assess the privacy risks - and identify the measures to be taken to address them - before a new RFID application is introduced into the market. For more information on PIA and to access the GS1 EPC/RFID **PIA Tool**, please visit http://www.gs1.org/epcglobal/pia/.

No matter if the chosen RFID tag is an applied or integrated one – it has to be **removable by the customer** after purchase.

In general, it **sometimes** is appropriate to have **different placements for the same category** of merchandise (e.g., as the items are designated for different genders or as some products contain metal fabrics).

For optimal readability and to prevent that tags are separated from the trade items, there are a couple of **placement choices to be avoided**:

- placing the EPC tag to **media** that is **attached to the hanger**
- placing the EPC tag where the **hanger clips** might shut (e.g. for denim, knit pants)
- direct contact with **metal** (please take into account that even a small proportion of metal fabrics in products can significantly impair the read performance)
- **folding** the EPC tag
- **attaching** the EPC tag **directly to the hanger**
- inserting an **inlay loosely** within a package

3.2.2 Illustrative examples for selected product categories

Trousers (pants, slacks, jeans, shorts)

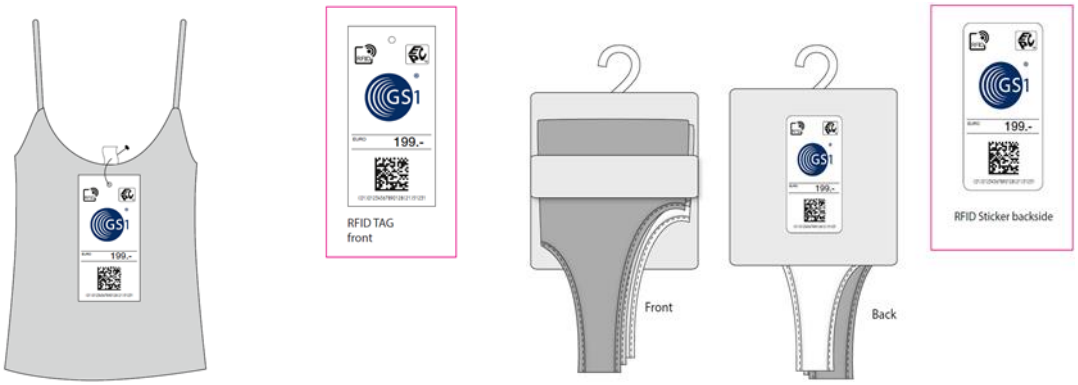
This category includes items such as denim, twill, woven, fleece, and knit pants, slacks, jeans, shorts, skirts, swim trunks, bike shorts, and boxer shorts with either a constructed, elastic, or drawstring waistband.

Recommended tag locations:

- Left rear waistband (see figure beneath, left-hand side)
- Left side waist seam (see figure beneath, right-hand side)
- Integrated in the brand label

Sleeveless tops and slips

This category includes items such as woven and knit sleeveless shirts, blouses, tank tops, halter tops, camisoles, crop tops, slips, and one piece swimwear, body wear, dancewear, panties, briefs, and girdles intended to be merchandised hanging.



Recommended tag locations:

- Inside the collar through the care or brand label (see figure beneath, left-hand side)
- Integrated in the care or brand label
- Affixed to a cardboard (see figure beneath, left-hand side)
- Left-side seam (for slips)

For a comprehensive description for all kinds of product categories please refer to the Format & Symbol Placement Guideline provided by GS1 US.

3.3 Tag performance (general advice)

Having an appropriate performance is critical for the success of an RFID implementation. In the past, it was preferred obtaining the highest performance (e.g. largest read range) possible. Nowadays, RFID technology (including tag performance) has reached a significant level of maturity. Thus, defining and maintaining RFID system performance has become equally important.

There are three major components having an impact on RFID tag performance:

- the RFID **chip-reader combination**,
- the **antenna size**, and
- the **environment**

In the context of RFID item level tagging, organisations can influence all three components:

(a) RFID **chip**s shall be **compliant to** the **UHF Gen 2** Air Interface Protocol **Standard** (see section 3.1) to support both multiple sourcing and an efficient communication between RFID tags and readers. Depending on the tag supplier, there are usually variances with regard to their characteristics which – in combination – can further improve the overall performance.

(b) The **antenna** shall have an adequate size. (For orientation: at the time of writing that guideline, RFID applications in the AFF sector typically require antenna sizes **between 50 x 30 mm and 70 x 15 mm**. However, antenna sizes most likely will become smaller in the future.)

(c) As to the **environment**, organisations should especially bear in mind that **metal** (e.g. in the item itself or in the store's furniture) **can impair** RFID **read performance**. For instance, if a garment consists of metallic threads, the RFID tag should not be integrated in the product, but applied on its outer side.

Note: a comprehensive overview on available passive UHF RFID tags including detailed test results on their performance (accomplished with various representative reference materials), their tag antenna designs and sizes is specified in the annual **EECC UHF Transponder Performance Survey (UTPS)**.

3.4 SGTIN back-up

In order to reconstruct the SGTIN EPC stored on an RFID tag (e.g., when a tag was lost or is not operational anymore), it is strongly recommended to have appropriate back-up. The latter is accomplished by applying an **additional symbology** which – in contrast to the EAN-13/UPC-A barcode – can also encode the serial number.

The GS1 General Specifications allow applying additional GS1 approved data carriers if trading partners mutually agree on it. (GenSpec 2017/2, section 2.1.2.3). Therefore, this guideline recommends the usage of the **GS1 DataMatrix** while indicating the encoded **GTIN and serial number** (GS1 Application Identifier '01' and '21') **in human readable interpretation (HRI)**. HRI represents the same characters as encoded or carried in the bar code or tag. HRI appears below or otherwise adjacent to a barcode, and can be used to reconstruct the contents of a GS1 data carrier in the event the latter cannot be read anymore.

Independently of what is specified subsequently, please note: for general distribution and scanning at retail POS, the **EAN-13/UPC-A barcode is always mandatory** on the **price label**.

Basically, one has to distinguish applied and integrated labels.

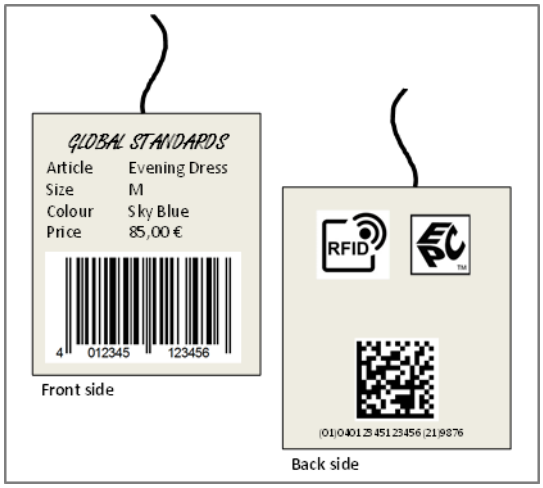
Companies opting for **applied labels** typically make use of one of the following three approaches:

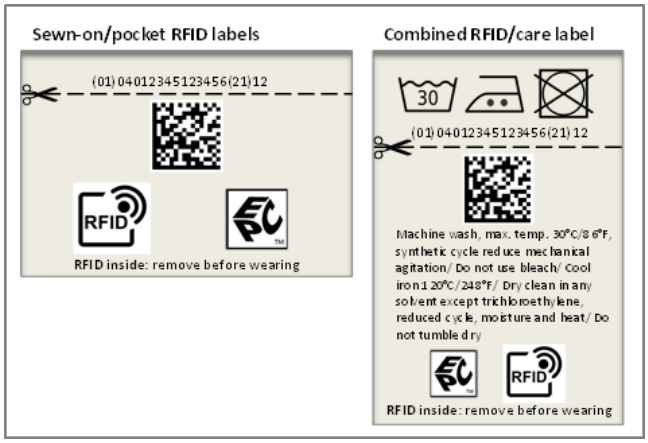
(a) combined price/RFID hang tag/label,

(b) adhesive RFID tags affixed on the price label's back side, or

(c) stand-alone (either hang or adhesive) RFID tags.

The right-hand side of the figure to the right provides an **illustrative example** of the elements to be included on the back side of a combined price/RFID hang tag/label (a), an adhesive RFID sticker (b) or a stand-alone RFID tag (c).





Companies which have gone for **integrated labels** typically make use of one of the following two approaches:

(a) sewn-on/pocket RFID labels, or

(b) combined RFID/care labels

For those cases**, illustrative examples** of the elements to be included on the respective labels are provided in the figure on the left-hand side.

As the latter two approaches go along with space constraints, it is justifiable to position the GS1 DataMatrix below the usual perforation line, while its accompanying HRI is placed above (along with the most crucial care

instructions). This ensures that the article's unique identification can be restored while enabling consumers to remove the part of the label conveying the RFID transponder.

Remark: **brand labels** incorporating RFID tags are usually not applicable to contain an SGTIN backup themselves. Rather, the SGTIN backup has to be provided through another label. However, this adds some complexity as serial numbers on two separate labels have to be matched accurately.

For an explanation of how a GTIN and its accompanying serial number are converted into an SGTIN EPC, refer to section 2.1. For a comprehensive description, see the corresponding GS1 RFID/Barcode Interoperability Guideline.

4 Quality Assurance

A constantly high tag performance is crucial for being able to conduct RFID-based use cases properly. Amongst other things, faulty RFID tags diminish data accuracy (e.g. in the course of stock taking or cycle counting), process reliability (e.g. in production, in electronic article surveillance, etc.), efficiency (e.g. delays in logistics operations) and – in the end – motivation of employees using the technology. Therefore, the following sub-sections provide guidance on measures to obtain and maintain high tag quality.

4.1 Maintaining high tag readability

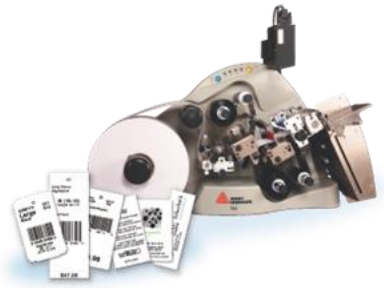
In general, all stakeholders physically handling RFID tags can contribute to a continuously high read performance. Thereby, it has been proven to be beneficial that all supply chain parties agree on certain performance levels and to implement downstream to upstream feedback loops ("I was provided with a quality level of X."). Each member of the supply chain has to ensure compliance with the respective quality criteria to prevent a downstream accumulation of quality issues.

The **inlay and tag/label manufacturer** (producing the finished tag/label ready for printing and encoding) should ensure that:

- inlays/tags/labels (either single, on rolls or on sheets) are correctly positioned,
- there are appropriate measures in place to verify both near and far field performance (e.g. by a 100% test in near field and random tests in far field),
- tags/labels are correctly pre-printed and that the performance is within predefined ranges, and
- faulty or weak inlays/tags/labels are marked, removed or destroyed.

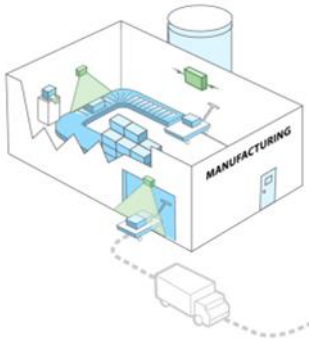
The **party printing/encoding the tag/label** should ensure that:

- the chip is encoded with the correct EPC,
- one and the same EPC is never encoded twice (except in those scenarios as outlined in section 2.3),
- the printing is correct and corresponds with the data (i.e. the GTIN and serial number) encoded on the chip,
- the performance is within predefined ranges (far field),
- the printed linear or 2d codes are in accordance with given quality requirements, and
- incorrectly or poorly printed/encoded tags/labels are marked, removed or destroyed and the missing number of tags/labels is replenished.



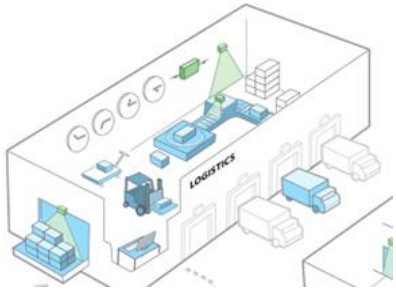
(Optional) The **producer** should:

- (at least at random) check the printed/encoded tags before commencing the production process e.g. by using an RFID handheld scanner and making a visual inspection,
- check the quality of the tags/labels at the time of attachment e.g. by using a fixed reader integrated in the packing table,
- check whether the captured SGTINs (read by an RFID handheld or tunnel scanner) correspond with the ordered quantities before goods issue. If there are any discrepancies, the respective logistics units should be sorted out and examined,
- ensure that RFID tags/labels are not placed too densely (i.e. < 1 cm) e.g. by alternating their orientations when packing tagged items into cartons, and
- remove and replace any faulty tags/labels.



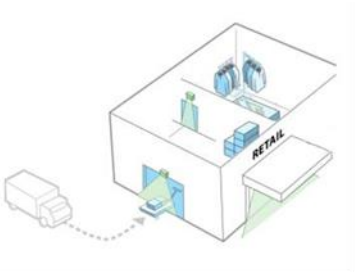
(Optional) The **logistics service provider** should:

- validate the incoming logistics units whether they contain the expected quantities (e.g. through an RFID tunnel reader) at goods receiving. If there are any discrepancies, the respective logistics units should be sorted out and examined),
- conduct exception processes as previously agreed with its customer (e.g. replacement of faulty tags, adjustment of advised quantities) if it turns out that there are faulty and/or missing tags/labels, and
- conduct a 100% item validation, i.e. removing/replacing misplaced items as well as faulty tags/labels in the course of packing and goods issue.



(Optional) The **retail store** should:

- conduct an RFID-based goods receiving process in order to determine whether agreed performance quality levels were met (thereby, it usually is sufficient to check each logistics unit whether it contains a number of EPCs exceeding a predefined threshold),
- carry out a 100% control on a random basis from time to time, and
- (when printing/teaching-in RFID tags) validate (in near field) that the tag can be read by means of the respective RFID printers/handhelds.

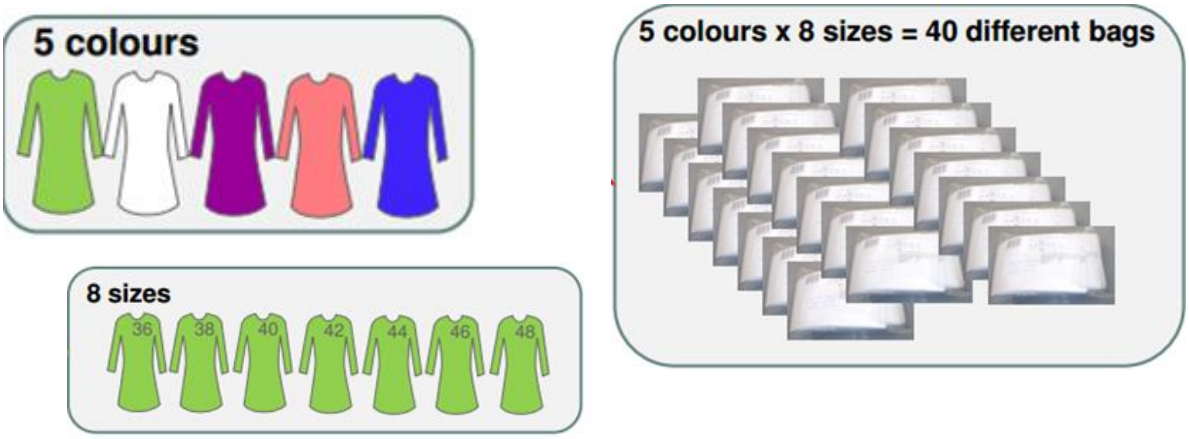


4.2 Applying tags to the right items

In order to ensure that tags are applied to the right items, organisations need to establish a well organised process for **fast and efficient matching** of tags and the items they are attached to. **Suitable indicators** for that matching are the **GTIN** and – depending on the type of label – the **supplier item number** as well as **colour** and **size** information. It is essential to ensure that the GTIN encoded in the EAN-13/UPC-A or GS1 DataMatrix corresponds with the SGTIN stored on the RFID tag.

It is recommended to **source RFID tags in assorted batches** (e.g. differentiated by the GTIN or any other applicable characteristic supporting the matching process). As a general rule of thumb,

RFID tags should be sorted the same way as price tags. Sorting can be best deployed by making use of poly bags, which are labelled appropriately (see figures beneath).



An additional help consists in **sorting** all **items** to be tagged **by colour and size**. Usually, tags are provided based on a production order to ensure that the right amount of RFID tags is available. In case the amount of RFID tags does not correspond with the number of items to be tagged, organisations should proceed as follows:

- **Leftovers of tags** do not need to be destroyed and **can be re-used** for future production **if** GTIN, supplier item number, colour, size and any other differentiating characteristics stay exactly the same. **Each item** shall be associated with **only one RFID tag/label** (i.e. it is not permissible putting leftovers of RFID tags/labels in pockets of finished goods).
- Any **shortshipment of tags** should immediately be communicated to the tag supplier and/or brand owner. RFID tags **must not** be copied.

The matching process depends on the tag/label type and tagging method. On the one hand, the matching of an applied tag/label requires just one step and allows for easier error handling (e.g. if mismatched tags/labels have to be replaced). On the other hand, the process involving an RFID-enabled care label can be more challenging as there are two steps (first, the matching of the care labels to the right item and, after production is finished, the matching to the corresponding price tags). In the latter case, it is advisable to print supplier item number, colour and size on the care label in order to ease the matching. Sewn-on labels (such as RFID enabled brand labels) require separate measures, e.g. a clear separation of the work flow according to the production order.

To ensure a high process quality, organisations should conduct **sample tests on a regular basis**.

4.3 Pitfalls and mistakes in the tagging process

Although RFID technology and especially RFID tags are getting more and more robust, users should be aware of some general pitfalls and mistakes to be avoided. Creating this awareness is part of quality assurance as it contributes to flawless operation of RFID along the supply chain.

The pictures below give a good overview of the most common mistakes. Especially **external forces like high pressure** (e.g. in the course of industrial washing processes such as stone washing) can physically destroy or damage an RFID tag. The same holds true for **bending** or **folding** RFID tags/labels. Therefore, it might be necessary to consider special process requirements when dealing with products that are equipped with integrated tags.

Another source of trouble for the functioning of an RFID tag consists in **water contact** and exposure to **high electric discharge**. In this context, washable RFID tags are usually encapsulated appropriately to prevent them from being destroyed by water contact. An RFID tag supplier can provide more information on the suitability of distinct tags. Last but not least, RFID tags/labels should not be attached directly on top of each other.

People responsible for dealing with RFID-tagged items should generally be advised to handle both items and tags with reasonable care.

5 Training

Multiple individuals within a company and also across companies are involved when deploying an RFID project. To ensure a project's success and a full leverage of efficiency gains and/or turnover uplift, it is vital to train every person involved. In general, it needs to be distinguished between **internal and external training** as the project's scope and involved processes might differ while a product moves along the supply chain. We would like to emphasise that trainings should not be limited to producers or persons who apply tags. In order to maintain high process conformity, all stakeholders should be considered to attend trainings.

Internal training should cover internal marketing of the project, motivation of employees involved, RFID-based processes, awareness as to privacy issues and change management in general. Users with experience in deploying RFID projects put forward that it is also essential to answer questions such as "Why is the introduction of RFID of high relevance for the company?", or "Which goals shall be achieved with the project?" Internal training is out of scope of this guideline though.

Therefore, the following paragraphs focus on **external training** which – up to this moment of time – have been carried out on a highly individual basis, oftentimes causing unnecessary double work for companies being trained (e.g. the producer or the logistics service provider) and companies requiring RFID training (e.g. the brand owner or retailer). The standardised training concept outlined in the following sections aims at resolving these redundancies and speed up the implementation process.

5.1 Form and content of a stakeholder training

This guideline recommends a modular toolbox approach in terms of the content to be trained depending on the project's complexity (basic vs. advanced). The focus is on technical and/or procedural subjects. As a general rule of thumb, we recommend to train 'as much as necessary and as little as possible'.

The training concept is divided in **level 1 ('basic')** and **level 2 ('advanced').** In level 1, organisations are only expected to attach RFID tags at previously specified positions on the garment. Thereby, tags are generally supplied by e.g. the brand owner. Producers do not necessarily have to read or encode tags. Level 2 is based on the assumption that a producer or any other stakeholder either reads tags and shares visibility event data based on EPCIS events with its business partners and/or encodes tags by itself.

Level 1 ('basic')

	Producer	Agency	Brand owner	Retailer	Logistics service provider	Freight forwarder	Solution provider
Basic RFID knowledge	M	M	M	M	M	O	X
Relevant GS1 standards	O	O	M	M	O	O	X
RFID within the apparel supply chain	O	O	M	M	O	O	X
Tag & tagging best practices	M	M	M	M	M	O	X
Individual processes (if applicable)	M	M	M	M	M	M	M
PIA	O	O	M	M	O	O	X
M = mandatory, O = optional, X = not relevant							

Level 2 ('advanced')

	Producer	Agency	Brand owner	Retailer	Logistics service provider	Freight forwarder	Solution provider
Basic RFID knowledge	M	M	M	M	M	M	X
Relevant GS1 standards	M	M	M	M	M	M	X
RFID within the apparel supply chain	M	M	M	M	M	M	X
Tag & tagging best practices	M	M	M	M	M	M	X
Individual processes (if applicable)	M	M	M	M	M	M	M
PIA	M	M	M	M	M	M	X
M = mandatory, O = optional, X = not relevant							

There are **several training techniques** companies can choose from, e.g. self-study, webinars, and face-to-face trainings.

To ensure at least the minimum required level of conformity, the stakeholder training should cover the following subjects: basic RFID knowledge with focus on the apparel sector, RFID-related GS1 standards, best practices as well as do's and don'ts for tag and label handling. Those subjects are addressed in the following sections.

5.2 Suggested training content

5.2.1 Basic RFID knowledge

It is very likely that training participants have never had any previous experience with RFID at all. Therefore, it is necessary to offer a complete as possible overview with respect to the technology (software & hardware), its current usage and its advantages. The goal of this section is to create a **sound basis of understanding**.

This training section shall cover the following topics in an understandable language:

- Introduction to RFID
- RFID usage in everyday life
- Components of an RFID system
- Privacy issues as regards to RFID
- Environmental impacts of RFID (i.e. carbon footprint reduction vs. waste)

5.2.2 Relevant GS1 standards

Along the entire AFF supply chain, GS1 standards are being used to identify items, capture data, and share information between business partners. A trend towards source tagging leads to the necessity to integrate stakeholders and technologies sometimes across distant regions. Standards constitute the basis to communicate and interact efficiently.

The below pictures highlight the corresponding GS1 standards and their relevance for deploying RFID in an apparel supply chain.

When implementing an RFID project it is necessary to move from **GTIN** (style, colour, size) to **SGTIN** (style, colour, size + serial number) to identify individual items (in other words, from class to instance level identification). To ensure a high process quality and conformity, it is vital for the stakeholders to understand the difference between the two concepts. Example: Although not accepted as common practice, producers sometimes copy existing price tags or care labels (including barcodes) when tags are missing. Having moved from GTIN to SGTIN, such wrongdoing would corrupt the entire system as a GTIN - serial number combination has to be unique (see section 2.1).

The **GLN** is used to identify legal entities and locations such as production facilities, distribution centres, retail stores, and sub-locations (e.g. goods receiving area within a distribution centre). Moreover, it might be required that logistics units (carton, pallet, etc.) have to be identified with an **SSCC** (Serial Shipping Container Code). Both GLN and SSCC are out of scope of this guideline though.

In an RFID context, there is usually more than one GS1 data carrier to capture the GTIN and/or SGTIN. Most of the users are already familiar with **EAN-13/UPC** barcodes encoding the GTIN. Nevertheless, it is necessary to remember that an EAN-13/UPC cannot store a serial number. Therefore, price tag, care label, brand label or a supplementary label accommodating an **EPC/RFID transponder** are usually also equipped with a **GS1 Data Matrix** to serve as proper backup for the SGTIN EPC (see sections 1.4 and 3.4). The training should cover all data carriers used in the respective RFID project.

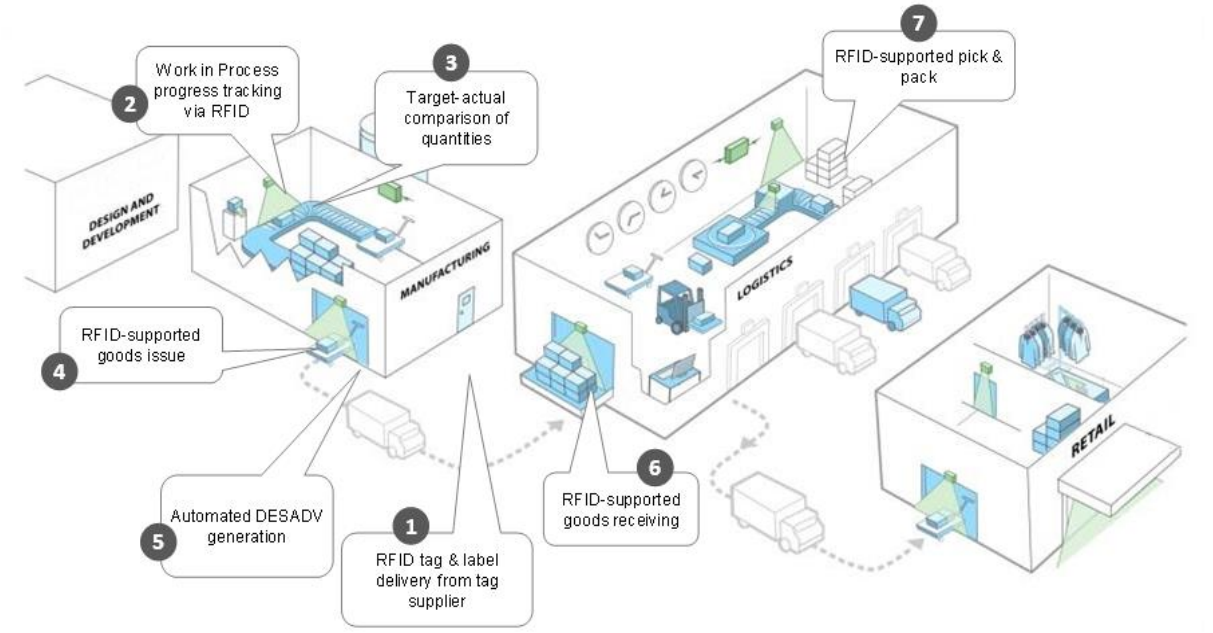
Within an RFID project, various communication standards might be employed to share data between stakeholders. Most of the users within the apparel supply chain are already familiar with **EANCOM** for the exchange of transactional data such as orders, advanced shipping notes or invoices. With respect to the above specified "advanced" level, it is recommended to make the training participants familiar with **EPCIS (EPC Information Services**). Thereby, it is vital to explain that EPCIS is the enabler for near to real-time visibility event data providing answers to four distinct questions, i.e. "what" (e.g. SGTIN of an item), "where" (e.g. GLN of a given location), "when" (timestamp), and "why" (e.g. business process such as 'packing').

The success of an EPC/RFID source tagging project depends on whether a company manages to deploy the technology in a way it best leverages efficiencies within its business processes. That part of the training is usually more customised as it depends on an organisation's project scope and set-up. This is why GS1 also provides a set of process standards, such as this guideline, explaining how to best **USE** and/or implement GS1 standards in the most appropriate way.

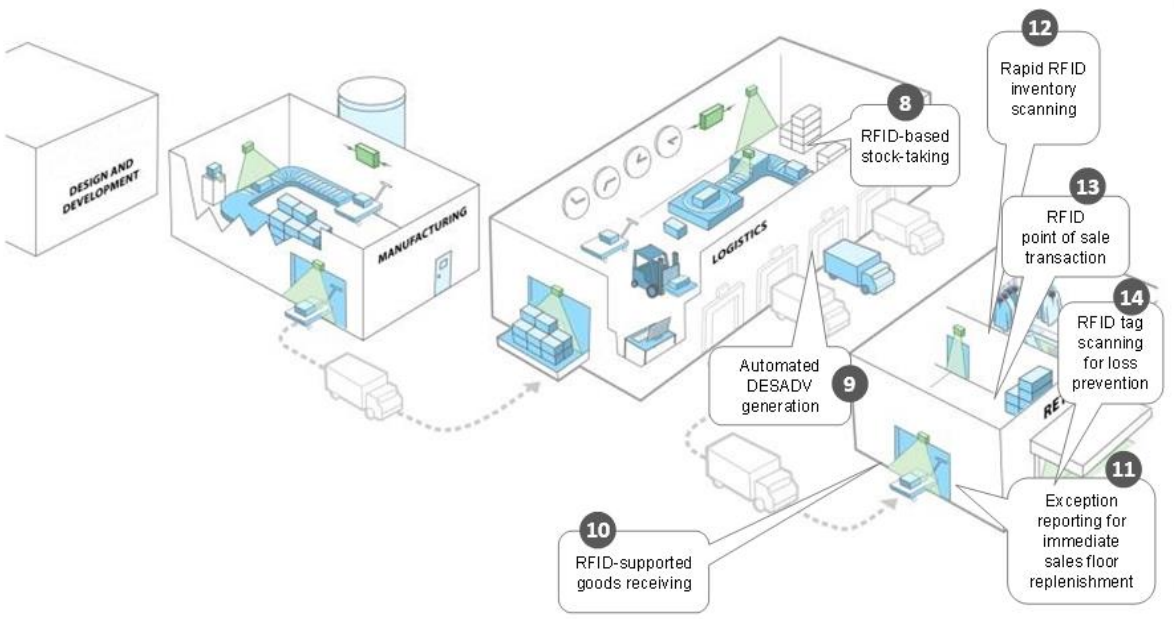
5.2.3 RFID within the apparel supply chain

In order to create a better understanding among all supply chain partners of why GS1 standards are adopted and why e.g. a brand owner plans to implement RFID and tag at source, the below tables and pictures provide an **overview of the most common use cases**. With respect to training, it will not be necessary to explain and/or understand all use cases. We recommend to select those that have the best fit with the own project's scope.

No.	Use Case	Description
1	RFID tag & label delivery from tag supplier	• Pre-encoded RFID tags are delivered from tag suppliers/label suppliers • RFID tags with SGTIN are applied to each garment.
2	Work in process progress tracking via RFID	• Tracking of production processes e.g. sewing, colouring, finishing of clothes. • Tracking of production progress e.g. against production plan.
3	Target-actual comparison of quantities	• Capture packing process by scanning item SGTINs and the carton ID (SSCC). • Capture loading process by scanning the carton SSCCs and the pallet SSCC. • Completeness check against order.
4	RFID-supported goods issue	• Automated capture of item/logistics unit IDs (or inference of logistics unit IDs if there are only RFID tags encoding item-level SGTINs). • Completeness check against packing or loading list.
5	Automated DESADV generation	• Based on outbound scan and shipping order, a despatch advice (DESADV) is created and sent to a recipient, e.g. the customer's distribution centre
6	RFID-supported goods receiving	• Automated capture of item/logistics unit IDs (or inference of logistics unit IDs if there are only RFID tags encoding item-level SGTINs). • Completeness check against DESADV.
7	RFID-supported pick & pack	• Completeness check of picked logistics units (cartons/packs) at RFID-enabled packing station by conducting a target-actual comparison against the picking order.



8	RFID-based stock-taking	• Accelerated inventory checking with either mobile or fixed RFID readers.
9	Automated DESADV generation	• Based on outbound scan and shipping order, a despatch advice (DESADV) is created and sent to a recipient, e.g. a customer's retail store..
10	RFID-supported goods receiving	• RFID scan of SGTINs with handheld/gate/fixed reader against advanced shipping note for completeness check and automated inventory booking. • Automated correction of stocks / inbound for correction in accounting processes.
11	Exception reporting for immediate sales floor replenishment	• Direct feedback to sales staff for immediate replenishment process on sales floor.
12	Rapid RFID inventory scanning	• Accelerated and permanent inventory taking with RFID handhelds on the sales floor and in the back room.
13	RFID point of sale transaction	• RFID scan at the cash desk for payment process. • Automated booking of sold clothes and deletion from "observation list" (EAS deactivation). • Automated correction of shop inventory (in real time).
14	RFID tag scanning for loss prevention	• RFID-based EAS functionality for theft protection at shop exit. Thereby, all RFID tagged items of the shop's inventory are monitored. • Deactivation process after cash process.



Please note that the above list does not claim to be complete. Rather, it shall support the explanation of the benefits of RFID source tagging through illustrative examples. To enable these use cases, goods need to be tagged properly. The next section will look into this matter and explain the relevance of tag & tagging best practices for RFID training. This part is considered mandatory for any training level or stakeholder except freight forwarders, which usually do not handle single items or tags.

5.2.4 Tag & tagging best practices

This section shall focus on best practices with respect to tags in general and the tagging process. It is recommended to integrate some practical demonstrations or videos within this part of the training to improve the level of understanding among participants and to reduce the participants' reservation and fears of the new technology.

General placement and handling of tags: As described in chapter 3.2 on tag placement, it is recommended to base this training section on the available placement guidelines, e.g. the EPC format and symbol placement guideline published by GS1 US. Moreover, it might be necessary to amend or adapt these placement best practices based on the project's needs and/or requirements derived from a brand owner's or retailer's production specifications.

Do's & don'ts for RFID tag & label handling: As there are various potential pitfalls and handling mistakes that can influence the success of an RFID project, it is recommended to ensure that all stakeholders involved are aware of the most important do's and don'ts for tag and label handling. In order to accomplish a sound understanding, this topic should be integrated in any form of training, e.g. by providing self-explanatory pictograms as shown in chapter 4.

5.2.5 Knowledge review

We recommend providing a **brief knowledge review or self-assessment after the training** to ensure a maximum understanding of the content presented. For example, it helps to identify topics that have not been fully understood by the participants so that the trainer can repeat those very subjects with the respective individuals.

A knowledge review could either follow an **open questions or multiple choice approach**. In general, any knowledge review should be in line with existing quality assurance standards within the respective companies. Moreover, the format might also depend on the training set-up, i.e.

classroom setting or e-learning platform etc., and local conditions such as illiterate persons and/or language constraints. The training itself (impart of theoretical knowledge accompanied by practical demonstrations) plus knowledge review constitute the basis for the certificate of participation. The latter shall indicate that employees have received a proper training to be able to meet the RFID project's requirements for item-level tagging in the AFF supply chain.

6 Sector-specific amendments

This section extends the recommendations given above with sector-specific guidance. Future versions of this document may include further extensions (e.g. for accessories) as GS1's AFF user community sees fit.

6.1 Amendment 1: Footwear

In principle, all contents of the previous sections are also applicable for the footwear industry. However, the shoe business is characterised by conditions and features that are different from the general apparel and fashion sector (see section 6.1.1). Against this background, this section complements the above recommendations to fulfil the specific requirements of the shoe sector.

The following subjects are **in scope** of this amendment:

- Description of specific requirements, characteristics and use cases of the shoe sector (e.g. to explain why there is a necessity to distinguish the left and right shoe)
- Overview on shoe-related tagging variances including a brief explanation on their respective advantages and disadvantages
- Recommendation on how to deal with privacy matters in case of embedded tags
- Guidance as to EPC back-up
- Discussion of the impact on RFID-based EAS in case there are more than one instance pertaining to one and the same trade item
- Brief information on business messages (note: no specification) when there is more than one RFID tag

In contrast to that, the following subjects are **out of scope**:

- Any matters related to trade items which are not specifically footwear (e.g. shoe polish)
- Dealing with NFC (Near Field Communication) technology
- Explanation of business cases (i.e. dealing with return on investment)

The subsequent paragraphs can help organisations to increase efficiency in a variety of use cases (including Industry 4.0 applications). In addition to the items listed in section 5.2.3, they e.g. support the following use cases (not exhaustive list):

No.	Use Case	Description
1	Automation of production	Support automation of production processes, for instance through precise tracking & tracing, matching of individual shoes and their assignment to the correct carton/box (which itself is labelled for multiple markets/countries)
2	Anti-counterfeiting	Enable organisations to reduce e.g. grey market activities and product counterfeiting
3	Acceleration of customer returns	Support of returns inspection/quality control
4	Shoe matching	Prevent customers (who sometimes mix shoes differing in size and shape) to leave a store with non-matching pairs
5	Display compliance	Conduct fast target/actual comparisons of how/whether product carriers (e.g. shelves) are equipped with specific shoes

6	Shoe localisation	Search for the exact counterpart of a given shoe (i.e. in terms of colour, texture, size and shape)
7	Matching shoes to the correct box	Enable shoe retailers (which store empty cartons in separate locations) to sell customers a given pair of shoes with their belonging box
8	Electronic Article Surveillance (EAS)	Benefit from RFID-based EAS irrespective of whether a trade item has one or several RFID tags
9	Consumer interaction and consumer experience	Enable direct interaction with customers through RFID-based devices/gadgets (e.g. intelligent shelves, fitting rooms, etc.) once they are approached by customers with at least one shoe of a given pair

6.1.1 Specifics of the shoe sector

In contrast to the general apparel and fashion sector, the shoe business has to deal with products consisting of two components (pairs of shoes), which entails a number of challenges. Amongst other things, shoes made of the very same batch of leather have to be packed together in order to avoid any variances in colour or quality. As left and right shoes are separate items and may be made at different work stations, there already is a need to track the left and right shoe during the production process (and beyond) to support an efficient matching of related shoes.

Even though shoes are usually always sold as a pair, they are not necessarily presented as a pair of shoes in the shops. There are a lot of different presentation philosophies which can be classified into two basic categories:

(a) **Presentation of individual shoes** (either the left or right ones), see left-hand side of the following figure

(b) **Pairwise presentation**, i.e. the related left and right shoes are presented together, see right-hand side of the following figure

The first case necessarily requires the contact between customer and sales representative if the customer wants to get the matching second shoe of a given pair, which is usually located in the shop's storage room. In this regard, display shoes are oftentimes switched within a specific time frame to prevent a shoe's colour to fade and to minimise any quality impairments due to too many try-ons. Especially retailers applying that kind of presentation can gain efficiencies if e.g. the

localisation of the related second shoe and the matching of a given pair were supported by RFID (requiring both shoes to be furnished with RFID tags).

That way, retailers are enabled to ensure both consistency (i.e. the left and right shoe are of the same size, colour and type) and accordance (i.e. both shoes of a given pair originate from the same batch/lot). (If shoes are never switched, shoe localisation does not necessarily require a second RFID tag. In such a case though, matching related shoes only works if the related display shoe is identified with a GTIN and serial number.)

Apart from gaining efficiencies and enhancing quality, RFID also supports a variety of up-to-date marketing applications. For instance, customers can be provided with item-related information when customers (wearing RFID-tagged shoes) approach RFID-based gadgets such as intelligent mirrors or changing rooms. In this case, each individual shoe needs to be tagged as those features need to work reliably no matter which shoe is taken.

Note: In addition to applying RFID tags to each individual shoe, organisations may even have the need for more than two RFID tags (e.g. if there is a need to match shoes to a customised box or to support returns processes with online retailers).

6.1.2 EPC Management

Depending on the intended use cases and forms of presentation, companies of the shoe sector may require more than one EPC tag on a trade item. The following paragraphs give guidance on how to proceed in the most common scenarios.

Scenario 1: just one RFID tag

If there is no need to identify the left and right shoe separately, users can proceed as described in chapter 2, i.e.:

(a) **Allocate a GTIN-13** (= GTIN-14 with pad character '0') to a trade item, e.g. '0401234512345 6'

(b) **Serialise** the **instances** of that trade item and **encode the RFID tags** according to one of the scenarios as outlined in section 2.3. Thereby, the **SGTIN filter value** should be set to '1' which marks a given SGTIN as POS trade item. Pursuing the above example and taking an arbitrary serial number (e.g. '9876'), the EPC Tag URI would look like this: `urn:epc:tag:sgtin-96:1.4012345.012345.9876`

(c) **Attach** the **RFID tag** (usually a hang or adhesive tag/label) to either one of the shoes or the carton

Note: this procedure is similar to most RFID shoe tagging projects to date which leverage just one RFID tag. Some implementations may have used another RFID filter value though, e.g. '0' (meaning "all others").

In a nutshell, the solution approach for scenario 1 can be illustrated as follows:

Instance/entity	Indicator digit	SGTIN filter value
Trade item (one tag on any shoe or the carton)	0	1

Taking the example of GTIN '04012345123456' and serial number '9876', the corresponding EPC Tag URI looks like this: `urn:epc:tag:sgtin-96:1.4012345.012345.9876`

Scenario 2: two RFID tags to link the left and right shoe

If there is a need to identify the left and right shoe of a given pair of shoes (which e.g. is necessary for advanced use cases such as shoe matching and shoe localisation), proceed as follows:

(a) **Allocate a GTIN-13** (= GTIN-14 with pad character '0') to a trade item, e.g. '04012345123456' (as in scenario 1)

(b) **Serialise** the **instances** of that trade item

(c) For each instance, allocate a **piece number** for the two shoes (= pieces) contained (**recommendation**: '01' for the left, '02' for the right-hand shoe)

Note: Allocating piece numbers must follow a **non-zero sequential numbering approach**, i.e. the first piece is identified with '01', the second one with '02', etc. In addition to that, the **total number of pieces must correspond with the highest piece number**, i.e. it is not permissible to assign piece number '05', when there are just two pieces in total. Despite the recommendation given above, companies should consider that there is **no normative specification for allocating piece numbers**, i.e. business processes should not rely on the fact that e.g. '01' always identifies left-hand shoes. (For some trading partners, it may be beneficial to agree on a consistent approach though.)

(d) **Encode the two RFID tags** with an Individual Trade Item Piece (ITIP) EPC with the **ITIP filter value** set to '0'. Using the above GTIN and taking the example of serial number '777', the corresponding EPC Tag URIs would look like this:

Left shoe: `urn:epc:tag:itip-110:0.4012345.012345.01.02.777`
Right shoe: `urn:epc:tag:itip-110:0.4012345.012345.02.02.777`

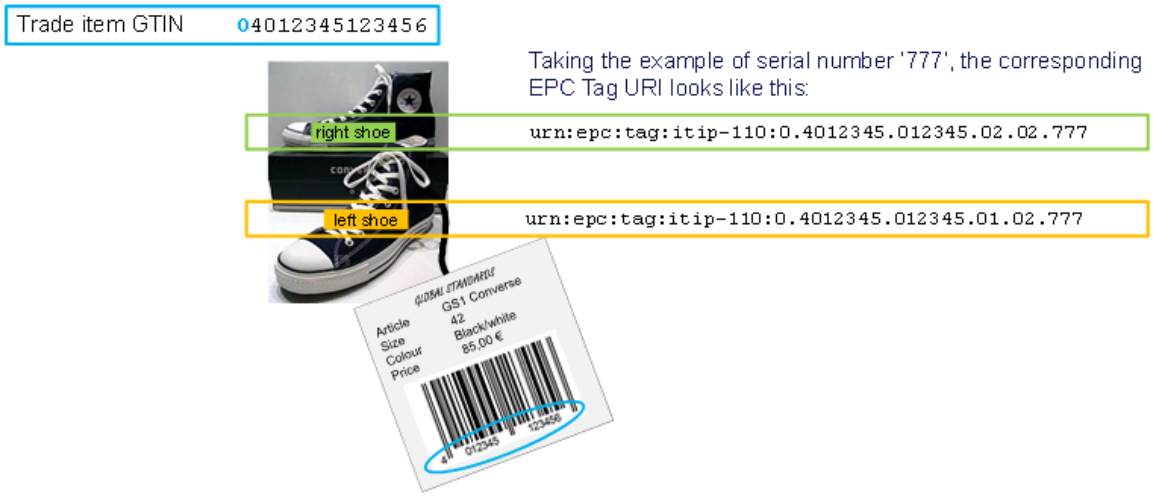
Note: ITIP, introduced as of EPC Tag Data Standard v. 1.11, is an EPC Header based on AI (8006), which comprises a GTIN, the number of a piece, and the total number of pieces the trade item consists of. As of GenSpec (version 17/2), it is permissible to use AI (8006) in conjunction with AI (21).

(e) **Attach the RFID tags** to the corresponding shoes

Note: The price label must always contain the trade item GTIN encoded in either an EAN-13 or UPC-A. Consequently, it is not allowed to just encode (8006) on it. The next paragraph provides further advice on that matter.

In a nutshell, the solution approach for scenario 2 can be depicted as follows:

Instance/entity	Indicator Digit	ITIP Filter Value	Pieces
Trade item piece (left-hand shoe, with dedicated RFID tag)	0	0	01 of 02
Trade item piece (right-hand shoe, with dedicated RFID tag)			02 of 02



Scenario 3: more than two RFID tags

In case there is the need to attach even more than two RFID tags to identify separate pieces belonging to the same trade item instance (e.g. the left shoe, the right shoe and a customised carton the shoes are packed into), organisations can proceed similar to the method as described for scenario 2.

Overall, the solution provides the opportunity to identify up to 99 trade item pieces.

6.1.3 Tag and Tagging

Tag Placement

In addition to the description in section 3.2, organisations of the shoe sector have the following options for tagging:

(a) **Applied** tags, e.g. an **adhesive tag** directly on a shoe (underneath the sole, underneath/ onto the inner sole, onto inner part of the shaft, etc.) or a carton (see left-hand figure below) or a **hang tag**, which is typically attached with a string/loop to the shoe (see right-hand figure below).

Note: When adhesive tags are directly applied to a shoe, the tag's glue should be strong enough to prevent the latter from falling off. At the same time, they should not damage the shoe or leave any residue when they are taken off. When placing tags underneath the sole, they should be sufficiently robust to cope with strain of pressure. Further, organisations should check whether the shoe sole contains any metal as the latter impairs RFID read performance (see general advice in section 3.2.1). With regard to hang tags, users should ensure that they cannot come off/be teared off easily.

(b) **Integrated** tags, e.g. heat seals (usually applied onto the tongue or the shaft) which – in contrast to embedded tags – are visible to the customer and which typically are not taken off immediately after purchase.

(c) **Embedded** tags, i.e. tags or inlays which were added to the shoe (e.g. inside the sole) during manufacturing and cannot be removed by consumers without damaging or modifying the product.

For orientation purposes, the following table summarises the major advantages and disadvantages of the most common/applicable tagging approaches:

Tagging option	Advantages	Disadvantages
Adhesive tag underneath the sole	• Easy to deploy • Easy to remove • Good visibility	• Easy to disable EAS functionality • Does not work on all surfaces • Can fall off

Adhesive tag onto inner sole	• Low risk of losing/damaging tag • Good visibility	• Space maybe too limited to convey all necessary information (especially in case of small shoes) • Exposed to abrasion
Hang tag	• Easy to remove • Good visibility	• Easy to disable EAS functionality
Heat seal	• No risk of losing the tag • High resilience of the tag	• (Usually) no possibility for SGTIN back-up • Hard to remove (potential privacy issue)
Integrated tag	• No risk of losing the tag • High resilience of the tag	• No possibility for SGTIN back-up • Impossible to remove (potential privacy issue)

Note: the usage of embedded and (non-removable) integrated tags still bears the risk of encountering privacy issues. At the time of updating this guideline, no detailed description of the embedding process is available yet. It is strongly recommended to discuss any application of embedded tags with PIA experts. A future version of this guideline may provide advice on how to use embedded tags in conformance with the respective privacy laws (e.g. by leveraging features as introduced in the EPC Gen2 v2 air interface standard, particularly the 'untraceable' function and the 'non-removable' flag).

EPC back-up

For the most part, the SGTIN/ITIP back-up strategy depends on two factors: the tag placement as outlined above and the chosen scenario as defined in section 6.1.2 With regard to the latter two approaches, this guideline recommends the following:

(a) In case of **scenario 1** (just one RFID tag), organisations can proceed similar to what is specified in section 3.4.

(b) In case of **scenario 2** (two RFID tags), organisations should proceed as follows:

- Apply an EAN-13/UPC-A to each trade item (mandatory)
- Equip both shoes with a tag/label containing a GS1 DataMatrix encoding AI (8006) – concatenating the GTIN, the piece number and the total number of pieces – as well as the serial number (AI 21).
- Referring to the recommendations given in section 3.1 and 3.4, this tag/label should also contain the RFID emblem, the EPC logo as well as the encoded GTIN and serial number in human readable form.

In practice, a correct labelling would e.g. look as follows:

6.1.4 RFID-based Electronic Article Surveillance (EAS)

If retailers are supplied with trade items having just **one RFID tag**, leveraging RFID as Electronic Article Surveillance is fairly easy to implement: In a nutshell, they need to populate and maintain a database containing all SGTIN EPCs of a store's inventory (e.g. by automatic data transfer from the supplier or by reading the tags upon goods receiving). Every time a trade item checkout is completed, the respective EPCs are deactivated. Thereby, 'deactivation' denotes the process of flagging or removing the SGTIN EPCs associated with the sold products from the database. In case an RFID reader at store exit reads an EPC which is not deactivated, it triggers an alarm.
For more information, please refer to the GS1 EPCglobal RFID-based Electronic Article Surveillance (EAS) Technical Implementation Guide.

If trade items have **more than one RFID tag** though (as it is the case for those companies tagging both the left and right shoe), retailers should – in addition to what is specified above – proceed as follows:

(a) Whenever shoes of a given pair can be mixed up, read and deactivate all RFID tags pertaining to a trade item in the course of the selling process.

Note: In order to diminish the risk of false alarms and other process errors, users should ensure that all RFID tags were captured/deactivated. For instance, the latter can be accomplished by software-driven means (through e.g. checking the total number of trade item pieces as encoded in the ITIP EPC or what is specified in the respective GTIN master data file) and an adequate instruction of the store personnel.

(b) If both shoes of a specific pair are always sold together (as it is the case with e.g. custom-made shoes), capture at least one RFID tag pertaining to such a trade item and automatically deactivate the related ITIP EPC.

Note: applying logic as needed for option (b) requires a retailer to have either precise knowledge of which serial numbers belong to which trade item instance or to have reliability that a supplier always assigns the very same serial number to the left-hand and the right-hand shoe (in using the solution approach for scenario 2 as described in section 6.1.2). In both cases, organisations should establish means preventing shoes to get mixed up.

6.1.5 Impact on business messages

This section aims at advising users on the effects on business messages if trade items are furnished with more than one RFID tag.

Within the share layer of the GS1 system of standards, there are **three categories of business data**: master data, transaction data, and visibility event data. With regard to the AFF sector and focussing on products, these categories can be characterised as follows:

- **Master data**: sets of descriptive attributes pertaining to trade items, e.g. product description, classification, etc. – typically synchronised prior to processing any recurring business documents.
- **Transaction data:** business documents that are shared bilaterally (via push) between trading partners to automate business transactions 'from order to cash', e.g. orders, despatch advices, invoices, sales reports.
- **Visibility event data:** records of the completion of business process steps (e.g. manufacturing, packing, shipping, receiving, stocking, selling) incorporating four data dimensions: what, when, where, and why – shared via push, publish/subscribe, or pull mode.

As a rule of thumb, **business messages on master data and transaction data remain untouched**: the left and right shoe still share the same set of trade item master data and will not (or very rarely) be ordered, invoiced, shipped and sold individually.

That said, there are situations in which organisations need to know what happened to an individual shoe, e.g. for quality control (e.g. that a matching pair was packed into the correct carton or sold to the customer) and returns management. Further, some business partners need to know each individual EPC prior to goods receipt (e.g. for Electronic Article Surveillance, see previous chapter).

In those cases, all EPCs need to be provided beforehand. The most efficient means to share that information is via **EPCIS**, the GS1 standard to capture and share **visibility event data**. Appendix A.1 provides sample XML for EPCIS events addressing the above listed business needs. Note that not all organisations necessarily need to set up a fully-fledged EPCIS infrastructure to share EPCIS messages.

7 List of abbreviations

Term	Definition
AFF	**A**pparel/**F**ashion/**F**ootwear
API	**A**pplication **P**rogramming Interface
DESADV	**D**espatch **a**dvice
EAS	**E**lectronic **A**rticle **S**urveillance
EDI	**E**lectronic **D**ata **I**nterchange
EPC	**E**lectronic **P**roduct **C**ode
EPCIS	**EPC I**nformation **S**ervices
GCP	**G**S1 **C**ompany **P**refix
GDD	**G**lobal **D**ata **Di**ctionary
GIAI	**G**lobal **I**ndividual **A**sset **I**dentifier
GTIN	**G**lobal **T**rade **I**tem **N**umber
HRI	**H**uman-**R**eadable **I**nterpretation
ILT	**I**tem **L**evel **T**agging
ITIP	**I**ndividual **T**rade **I**tem **P**iece
NOS	**N**ever **O**ut **o**f **S**tock
PIA	**P**rivacy **I**mpact **A**ssessment
POS	**P**oint **o**f **S**ales
RFID	**R**adio **F**requency **I**dentification
SGTIN	**S**erialised **G**lobal **T**rade **I**tem **N**umber
TDS	**T**ag **D**ata **S**tandard
TID	**T**ag **I**dentifier
UHF	**U**ltra-**H**igh **F**requency
UPC	**U**niversal **P**roduct **C**ode
URI	**U**niform **R**esource **I**dentifier
URL	**U**niform **R**esource **L**ocator

8 References

Apparel and General Merchandise – Format & Symbol Placement for the Electronic Product Code (EPC), GS1 US Guideline, August 2014, https://www.gs1us.org/documents?Command=Core_Download&EntryId=429

EECC UHF Tag Performance Survey 2013/14, August 2013, http://eecc.info/eecc-uhf-tag-performance-survey/?lang=en

EPC-enabled RFID Serialization Management for SGTIN-96, GS1 US Guideline, May 2012, http://www.gs1us.org/gs1-us-library?Command=Core_Download&EntryId=860

GS1 RFID/Barcode Interoperability Guideline, Version 1.1, November 2016, https://www.gs1.org/standards/bc-epc-interop

GS1 Core Business Vocabulary (CBV) Standard, Version 1.2.1, May 2017, http://www.gs1.org/gsmp/kc/epcglobal/cbv

GS1 EPC Information Services (EPCIS) Specification, Version 1.2, September 2016, http://www.gs1.org/gsmp/kc/epcglobal/epcis

GS1 EPC Radio-Frequency Identity Protocols Generation-2 UHF RFID, Version 2.0.0, November 2013, http://www.gs1.org/gsmp/kc/epcglobal/uhfc1g2

GS1 EPCglobal RFID-based Electronic Article Surveillance (EAS), Technical Implementation Guide, Issue 1.0, September 2009, http://www.gs1.org/epc-rfid

GS1 General Specifications (GenSpec) Version 17/2; July 2017, http://www.gs1.org/barcodes-epcrfid-id-keys/gs1-general-specifications

GS1 Logistics Interoperability Model (GS1 LIM), Version 1, August 2007, http://www.gs1.org/sites/default/files/docs/sectors/transportlogistics/LIM_Foundation_Report.pdf

GS1 Tag Data Standard (TDS), Version 1.11, Community Version Draft (unratified), July 2017, http://www.gs1.org/gsmp/kc/epcglobal/tds/

Guidelines on EPC for Consumer Products, http://www.gs1.org/epcglobal/public_policy/guidelines

ISO/IEC 29160:2012. Information technology – Radio frequency identification for item management – RFID Emblem, http://www.iso.org/iso/catalogue_detail?csnumber=45239

Appendix

A.1 XML Examples for section 6.1.5

The following EPCIS XML structures give an impression of how the challenges mentioned in section 6.1.5 can be supported through EPCIS. Please take into account the following important notes:

(a) The message examples are **no normative specifications**. They are for **illustration purposes only.**

(b) The messages are based on **EPCIS/CBV v. 1.2.**

(c) In the present case, it is presumed that there are two trade item pieces (left- and right-hand shoe), each of them furnished with an RFID tag.

Example 1: Document the matching of pairs of shoes e.g. when picking or selling them

```
<epcis:EPCISDocument xmlns:epcis="urn:epcglobal:epcis:xsd:1" schemaVersion="1.2" creationDate="2016-11-14T15:05:00.000+01:00">
   <EPCISBody>
      <EventList>
         <ObjectEvent>
            <eventTime>2016-11-14T15:04:00.638+01:00</eventTime>
            <eventTimeZoneOffset>+01:00</eventTimeZoneOffset>
            <epcList>
               <epc>urn:epc:id:itip:4012345.011111.01.02.1234</epc>
               <!-- GTIN: 04012345111118 | piece no: 01 | total pieces: 02 | serial: 1234  -->
               <epc>urn:epc:id:itip:4012345.011111.02.02.1234</epc>
               <!-- GTIN: 04012345111118 | piece no: 02 | total pieces: 02 | serial: 1234  -->
            </epcList>
            <action>OBSERVE</action>
            <bizStep>urn:epcglobal:cbv:bizstep:picking</bizStep>
            <disposition>urn:epcglobal:cbv:disp:in_progress</disposition>
            <readPoint>
               <id>urn:epc:id:sgln:4012345.00020.0</id>
               <!-- GLN: 4012345000207 -->
            </readPoint>
         </ObjectEvent>
      </EventList>
   </EPCISBody>
</epcis:EPCISDocument>
```

or

```
<epcis:EPCISDocument xmlns:epcis="urn:epcglobal:epcis:xsd:1" schemaVersion="1.2" creationDate="2016-11-15T16:10:00.000+01:00">
   <EPCISBody>
      <EventList>
         <ObjectEvent>
            <eventTime>2016-11-15T16:07:00.638+01:00</eventTime>
            <eventTimeZoneOffset>+01:00</eventTimeZoneOffset>
            <epcList>
               <epc>urn:epc:id:itip:4012345.011111.01.02.98765</epc>
               <epc>urn:epc:id:itip:4012345.011111.02.02.98765</epc>
            </epcList>
            <action>OBSERVE</action>
            <bizStep>urn:epcglobal:cbv:bizstep:retail selling</bizStep>
            <disposition>urn:epcglobal:cbv:disp:retail_sold</disposition>
            <readPoint>
               <id>urn:epc:id:sgln:0614141.00035.0</id>
               <!-- GLN: 0614141000357 -->
            </readPoint>
         </ObjectEvent>
      </EventList>
   </EPCISBody>
</epcis:EPCISDocument>
```

Example 2: providing customers with the ITIP EPCs that are shipped to a specific location

Notes with regard to the exemplary EPCIS document:

(1) The (optional) **EPCIS Header** can be used to convey a set of simple trade item, party or location master data so that a recipient is enabled to immediately interpret the contents of the EPCIS events included in an EPCIS document even if the corresponding master data is not available.
For a complete list of standard master data attributes available so far, please refer to the CBV standard (section 9 for trade item master data; section 10 for location and party master data).

(2) The '**Packing Event**' contains the ITIPs identifying the individual shoes as well as the SSCC of the pack or box they have been packed into.

(3) The '**Departing Event**' includes a business transaction reference (here: an invoice identifier) to ease the linkage between the event and its related business transaction.
It also accommodates source and destination identifiers to indicate the sending/receiving organisation as well as the specific location the goods are shipped to.

```
<epcis:EPCISDocument xmlns:epcis="urn:epcglobal:epcis:xsd:1"
xmlns:sbdh="http://www.unece.org/cefact/namespaces/StandardBusinessDocumentHeader"
xmlns:epcismd="urn:epcglobal:epcis-masterdata:xsd:1" xmlns:cbvmd="urn:epcglobal:cbv:mda"
schemaVersion="1.2" creationDate="2016-07-26T15:14:27.574+01:00"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="urn:epcglobal:epcis:xsd:1
EPCglobal-epcis-1_2.xsd">
   <EPCISHeader>
      <sbdh:StandardBusinessDocumentHeader>
         <sbdh:HeaderVersion>1.0</sbdh:HeaderVersion>
         <sbdh:Sender>
            <sbdh:Identifier Authority="SGLN">urn:epc:id:sgln:4012345.00000.0
            </sbdh:Identifier>
         </sbdh:Sender>
         <sbdh:Receiver>
            <sbdh:Identifier Authority="SGLN">urn:epc:id:sgln:4023338.00000.0
            </sbdh:Identifier>
         </sbdh:Receiver>
         <sbdh:DocumentIdentification>
            <sbdh:Standard>EPCglobal</sbdh:Standard>
            <sbdh:TypeVersion>1.0</sbdh:TypeVersion>
            <sbdh:InstanceIdentifier>98765</sbdh:InstanceIdentifier>
            <sbdh:Type>Events</sbdh:Type>
            <sbdh:CreationDateAndTime>2016-07-26T15:14:27.574+01:00
            </sbdh:CreationDateAndTime>
         </sbdh:DocumentIdentification>
      </sbdh:StandardBusinessDocumentHeader>
      <extension>
         <EPCISMasterData>
            <VocabularyList>
               <Vocabulary type="urn:epcglobal:epcis:vtype:EPCClass">
                  <VocabularyElementList>
                     <VocabularyElement id="urn:epc:idpat:itip:4012345.011111.01.02.*">
                        <attribute id="urn:epcglobal:cbv:mda#descriptionShort">Running Shoe Blue, Model
                        X, Size 42, left shoe</attribute>
                     </VocabularyElement>
                     <VocabularyElement id="urn:epc:idpat:itip:4012345.011112.01.02.*">
                        <attribute id="urn:epcglobal:cbv:mda#descriptionShort">Running Shoe Blue, Model
                        X, Size 43, left shoe</attribute>
                     </VocabularyElement>
                     <VocabularyElement id=" urn:epc:idpat:itip:4012345.011111.02.02.*">
                        <attribute id="urn:epcglobal:cbv:mda#descriptionShort">Running Shoe Blue, Model
                        X, Size 42, right shoe</attribute>
                     </VocabularyElement>
                     <VocabularyElement id=" urn:epc:idpat:itip:4012345.011112.02.02.*">
                        <attribute id="urn:epcglobal:cbv:mda#descriptionShort">Running Shoe Blue, Model
                        X, Size 43, right shoe</attribute>
                     </VocabularyElement>
                  </VocabularyElementList>
               </Vocabulary>
```

```
            <Vocabulary type="urn:epcglobal:epcis:vtype:Location">
               <VocabularyElementList>
                  <VocabularyElement id="urn:epc:id:sgln:4012345.00000.0">
                     <attribute id="urn:epcglobal:cbv:mda#name">Company A</attribute>
                  </VocabularyElement>
                  <VocabularyElement id="urn:epc:id:sgln:4012345.00011.0">
                     <attribute id="urn:epcglobal:cbv:mda#name">Company A, Distribution Centre
                     1</attribute>
                  </VocabularyElement>
                  <VocabularyElement id="urn:epc:id:sgln:4023338.00000.0">
                     <attribute id="urn:epcglobal:cbv:mda#name">Company B</attribute>
                  </VocabularyElement>
                  <VocabularyElement id="urn:epc:id:sgln:4023338.00123.0">
                     <attribute id="urn:epcglobal:cbv:mda#name">Company B, Retail Store
                     123</attribute>
                  </VocabularyElement>
               </VocabularyElementList>
            </Vocabulary>
         </VocabularyList>
      </EPCISMasterData>
   </extension>
</EPCISHeader>
<EPCISBody>
   <EventList>
      <AggregationEvent>
         <eventTime>2016-07-26T10:58:56.591Z</eventTime>
         <eventTimeZoneOffset>+02:00</eventTimeZoneOffset>
         <parentID>urn:epc:id:sscc:4012345.0111111122</parentID>
         <!-- SSCC: 040123451111111226 -->
         <childEPCs>
            <epc>urn:epc:id:itip:4012345.011111.01.02.98765</epc>
            <epc>urn:epc:id:itip:4012345.011111.02.02.98765</epc>
            <epc>urn:epc:id:itip:4012345.011111.01.02.123</epc>
            <epc>urn:epc:id:itip:4012345.011111.02.02.123</epc>
            <epc>urn:epc:id:itip:4012345.011155.01.02.7612</epc>
            <epc>urn:epc:id:itip:4012345.011155.02.02.7612</epc>
         </childEPCs>
         <action>ADD</action>
         <bizStep>urn:epcglobal:cbv:bizstep:packing</bizStep>
         <readPoint>
            <id>urn:epc:id:sgln:4012345.00011.0</id>
            <!-- GLN: 4012345000115 -->
         </readPoint>
      </AggregationEvent>
      <ObjectEvent>
         <eventTime>2016-07-26T14:02:56.591Z</eventTime>
         <eventTimeZoneOffset>+02:00</eventTimeZoneOffset>
         <epcList>
            <epc>urn:epc:id:sscc:4012345.0111111122</epc>
         </epcList>
         <action>OBSERVE</action>
         <bizStep>urn:epcglobal:cbv:bizstep:departing</bizStep>
         <readPoint>
            <id>urn:epc:id:sgln:4012345.00011.0</id>
         </readPoint>
         <bizTransactionList>
            <bizTransaction type="urn:epcglobal:cbv:btt:inv">
            urn:epcglobal:cbv:bt:4012345000009:RE1099</bizTransaction>
         </bizTransactionList>
         <extension>
            <sourceList>
               <source type="urn:epcglobal:cbv:sdt:possessing_party">
               urn:epc:id:sgln:4012345.00000.0</source>
               <!-- GLN: 4012345000009 -->
            </sourceList>
            <destinationList>
               <destination type="urn:epcglobal:cbv:sdt:possessing_party">
               urn:epc:id:sgln:4023338.00000.0</destination>
               <!-- GLN: 4023338000005 -->
               <destination type="urn:epcglobal:cbv:sdt:location">
               urn:epc:id:sgln:4023338.00123.0</destination>
               <!-- GLN: 4023338001231 -->
```

```
            </destinationList>
          </extension>
        </ObjectEvent>
      </EventList>
   </EPCISBody>
</epcis:EPCISDocument>
```

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