GS1 US

The Global Language of Business

GS1 US RFID Claims Compliance Guideline for the Apparel Industry

Release 1.1, November 7, 2023

Table of Contents

About GS1

GS1® is a neutral, not-for-profit, global organization that develops and maintains the most widely used supply chain standards system in the world. GS1 Standards improve the efficiency, safety, and visibility of supply chains across multiple sectors. With local Member Organizations in over 110 countries, GS1 engages with communities of trading partners, industry organizations, governments, and technology providers to understand and respond to their business needs through the adoption and implementation of global standards. GS1 is driven by over a million user companies, which execute more than six billion transactions daily in 150 countries using GS1 Standards.

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GS1 US®, a member of GS1 global, is a not-for-profit information standards organization that facilitates industry collaboration to help improve supply chain visibility and efficiency through the use of GS1 Standards, the most widely used supply chain standards system in the world. Nearly 300,000 businesses in 25 industries rely on GS1 US for trading partner collaboration that optimizes their supply chains, drives cost performance and revenue growth, while also enabling regulatory compliance. They achieve these benefits through solutions based on GS1 global unique numbering and identification systems, barcodes, Electronic Product Code (EPC®)-based RFID, data synchronization, and electronic information exchange. GS1 US also manages the United Nations Standard Products and Services Code® (UNSPSC®).

Document Summary

Document Item	Current Value
Document Title	RFID Claims Compliance Guideline
Date Last Modified	November 2023
Document Description	This guideline specifies best practices for avoiding and detecting Carton Pack and Carton Shipment inaccuracies. This document also highlights the use cases for specific process (such as packing, inspecting, or receiving) that can be automated or enhanced using RFID technology.
Version 1.1 Changes	• Added additional EPCIS technical links in section 8.2 • Updated section 8.3 to show EPCIS 2.0 examples with JSON-LD

Glossary

Term	Definition	Also Known As
Advanced Shipment Notice	A standardized business-to-business electronic document that is generated by a supplier to inform a customer of shipped product. This links the shipment to the customer purchase order and facilitates efficiencies in the order-to-cash cycle.	ASN
Application Programming Interface	A software intermediary that allows two applications to communicate.	API
Carton Pack Accuracy	Measure of expected items (saleable units) versus actual items in a specific carton (concealed shortage, overage, substitution).	
Carton Shipment Accuracy	Measure of expected cartons for a given shipment versus actual cartons (carton shortage, overage)	
Case/Carton	These terms are used interchangeably in this document, denoting any container of items for B2B shipment purposes.	
Chargeback	A financial penalty assessed by a customer to a vendor for failure to adhere to prescribed terms and conditions.	
Claim	For the purposes of this document, a Claim refers to a demand made by a customer to a vendor as a result of finding Carton Pack Inaccuracy or Carton Shipment Inaccuracy. This could be a financial penalty for not receiving what was invoiced and/or returning what was not ordered, resulting in an actual reduction of invoice payment and/or costs or burden related to returns.	
Commercial-off-the-shelf	Software or hardware that already exists and is available from commercial sources and is available for sale to the general public.	COTS
Core Business Vocabulary	The Core Business Vocabulary (CBV) specifies the structure of vocabularies and specific values for the vocabulary elements to be utilized in conjunction with GS1 EPCIS for data sharing both within and across enterprises. Designed to ensure a common understanding of data semantics, the use of the CBV is critical to the interoperability of EPCIS implementations. Examples of these vocabulary elements include "shipping," "receiving," and "inspecting."	CBV
Cross-Docked Case/Carton	A case/carton where the contents are not removed and redistributed by the handling DC. The carton content remains unchanged between receiving and shipping.	Full Case Pick
Electronic Product Code	An identification scheme for universally identifying physical objects (e.g., trade items, assets, and locations) via RFID tags and other means. The standardized EPC data consists of an EPC (or EPC Identifier) that uniquely identifies an individual object, as well as an optional filter value when judged to be necessary to enable effective and efficient reading of the EPC tags.	EPC

Term	Definition	Also Known As
EPC Information Services	A GS1 standard that enables trading partners to share visibility event data about the physical movement and status of products as they travel throughout the supply chain – from business to business and ultimately to consumers.	EPCIS
Failure Modes and Effects Analysis	Specific to this guideline, this relates to the list of possible Carton Pack Accuracy errors and the potential impact that may result.	FMEA
Global Location Number	The GS1 identification key used to identify any type of party or location used in business processes. (i.e., legal entity, function, fixed physical location, mobile physical location, digital location) The key comprises a GS1 Company Prefix, location reference, and check digit.	GLN
Global Trade Item Number™	The GS1 identification key used to identify trade items. The key comprises a GS1 Company Prefix, an item reference, and check digit.	GTIN™ or AI (01)
GS1 Application Identifier	GS1 Application Identifiers (AIs) are prefixes used in barcodes and EPC/RFID-tags to define the meaning and format of data attributes.	AI
GS1-128 barcode symbology	A subset of Code 128 which uses the function that allows the encoding of element strings. GS1-128 barcodes are used for business-to-business identification of shipment units such as cartons.	GS1-128
Load Plan	A document that accompanies a purchase order specifying case/carton pack requirements.	
Mask Designer ID	This data is encoded by the RFID chip provider in a read-only memory bank and provides the chip manufacturer and model information.	MDID
Radio Frequency Identification	A technology that uses radio frequency electromagnetic fields or waves to automatically identify and track tags attached to objects. An RFID system consists of RFID tags and readers. When triggered by a radio frequency electromagnetic interrogation signal from a nearby RFID reader antenna, the RFID tag transmits digital data, usually a unique identifier like an EPC, back to the reader. For the purposes of this document, the term RFID refers to the UHF frequency band technology, also known as RAIN RFID.	RFID
Repacked Case/Carton	A case/carton where the contents are removed and redistributed by the handling DC. The carton content is changed between receiving and shipping.	Post-Receipt Allocation
Serial Shipping Container Code	The GS1 identification key used to identify logistics units. The key comprises an extension digit, GS1 Company Prefix, serial reference, and check digit.	SSCC
Serialized Global Trade Item Number	The Serialized Global Trade Item Number EPC scheme is used to assign a unique identity to an instance of a trade item, such as a specific instance of a product or SKU.	SGTIN
Serial Number	A serial number is assigned to an entity for its lifetime. When combined with a GTIN, a serial number uniquely identifies an individual item.	AI (21)

Term	Definition	Also Known As
Serialized Global Location Number	GS1's EPC Tag Data Standard (TDS) defines the SGLN as a Global Location Number (GLN), with or without the optional extension (AI 254), which is used to identify physical locations. Examples of such locations include a specific building or unit of shelving within a warehouse.	SGLN
Use Case	For the purposes of this document, this term describes any specific process (such as packing, inspecting, or receiving) that is automated or enhanced using RFID technology.	

Executive Summary

RFID technology enables the fast and accurate identification of products, helping retailers and brands increase inventory accuracy and improve supply chain visibility. Since RFID technology does not require line-of-sight, a case/carton of items on a conveyor may be automatically read and checked for accuracy with no impact on throughput. By exchanging this data, trading partners can simplify and expedite dialogue regarding claims.

This guideline specifies best practices for avoiding and detecting Carton Pack and Carton Shipment inaccuracies. This document also highlights the use cases for specific process (such as packing, inspecting, or receiving) that can be automated or enhanced using RFID technology.

Important: This document is voluntary, not mandatory. It should be noted that use of the words "must" and "require" throughout this document relate exclusively to technical recommendations for the proper application of the standards to support the integrity of your implementation.

1 Introduction

Item-level RFID is used by many retailers to enhance store operations and greatly increase in-store inventory accuracy[1]. But there remains untapped potential in leveraging EPC/RFID for the purpose of aiding in supply chain visibility to support claims compliance and reconciliation. Research has shown there are significant recurring cost-saving opportunities to be realized to this end[2]. While not as mature as retail store best practices, Distribution Center processes may be substantially aided by the sharing of serialized data not previously distributed between trading partners.

1.1 Business Benefits

As seen in a study completed by Auburn University, the Carton Pack and Carton Shipment Inaccuracy that results in Claims and Chargebacks costs more than the RFID tags, scanning equipment, and other setup costs.[3]

There are additional expenses that are harder to quantify. These relate to the administrative effort made to document and drive trading partner business negotiations, final settlement costs, and the accounting of working capital under dispute in the significant period of time before disputes are settled. Looking further, the exchange of serialized item-level data between trading partners unlocks other opportunities relating to product authenticity, grey market tracking, value-added services, and reverse logistics.

This is all in addition to the cost of inventory inaccuracy realized by inaccurate shipments. Inventory accuracy enables omni-channel efficiencies such as reduced pick times, reduced picking nulls and order substitution, reduced markdowns, more efficient use of space, inventory, and resources, and a greater scope of product marketed online.

1.2 Scope

In Scope	Out of Scope
• Cases/Cartons with all contained items having EPC/RFID item-level source (factory) tagging and GS1 Standards-compliant barcodes. • Guidance for factory inspection or scan/pack use cases. • Guidance for Brand and Retail Distribution Center conveyance operations. • Elements of this may also be applied to store receiving operations and Third-Party Logistics Providers (3PLs).	• Distribution Center audits of criteria outside of Carton Pack or Carton Shipment Accuracy • Garment on hanger (outside of a case/carton)

1.3 Who will use this document?

This guideline specifies an implementation of GS1 Standards whereby item-level data is shared and leveraged between trading partners. This document is applicable to industry stakeholders such as solution providers and IT staff, operations managers for factories, operations managers for brands and retailer distribution centers, and third-party logistics operations managers. This guideline may also apply to certain store operations where brand-to-store direct shipments occur.

[1] Case studies such as: https://www.gs1uk.org/sites/default/files/inline-files/gs1_uk_the_impact_of_rfid_report.pdf and https://www.gs1us.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=2443

[2] See https://www.gs1us.org/industries/apparel-general-merchandise/standards-in-use/project-zipper

[3] IBID

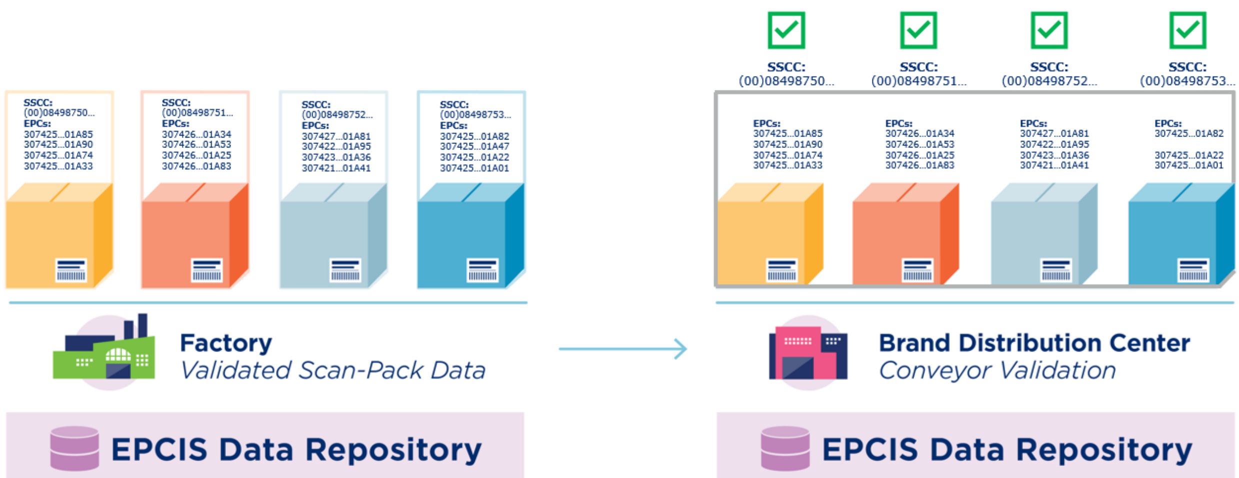
2 Solution Design: Factory to Brand

2.1 Carton Shipment Accuracy

The core concept of the solution design is that factories are best positioned to capture item-level data and associate that data to a specific case/carton when packing or inspecting. **FIGURE 2-1** below depicts this on the left showing each carton with its own carton identifier, the Serial Shipping Container Code (SSCC), and list of unique items, the EPCs.

Distribution centers with conveyors ideally would not need to create the physical space required to isolate and read each carton for inspection. Instead, the solution design allows for item-level data to be read without directly associating each item to a case/carton. This is depicted in **FIGURE 2-1** as well. Cross referencing the EPCs read in the distribution center to the factory-provided data allows evidence of each carton to be captured. In **FIGURE 2-1**, all four cartons are detected based on reads of item-level EPC cross referenced with the factory-provided data supplied via EPCIS. This shows a means of checking Carton Shipment Accuracy.

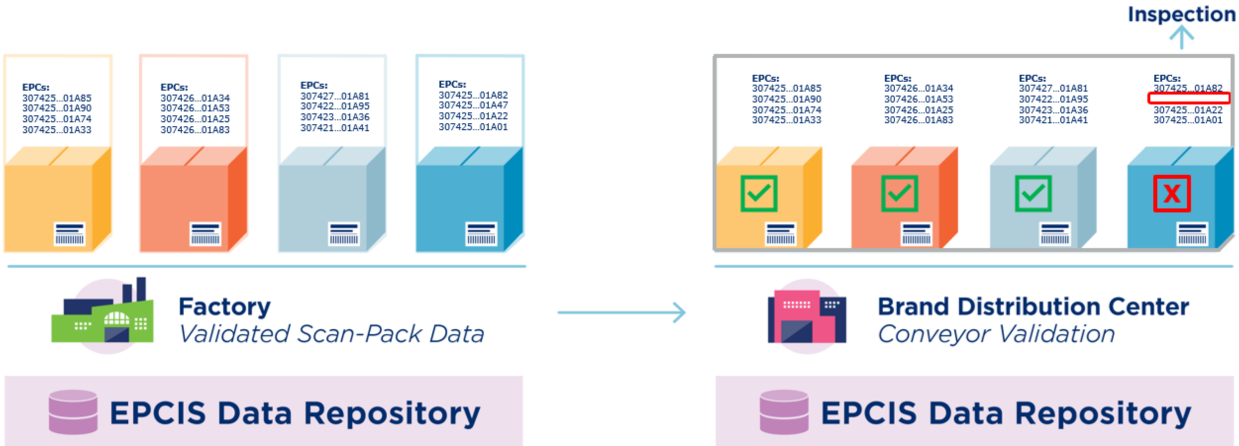
FIGURE 2-1



2.2 Carton Pack Accuracy

The same process may also be applied to measure Carton Pack Accuracy. Instead of only confirming that specific case/cartons are present, the presence of expected EPC values can serve as a means of automatically confirming Carton Pack Accuracy, and the absence of expected EPC values can be used to divert a case/carton for inspection. This is depicted in **FIGURE 2-2** below.

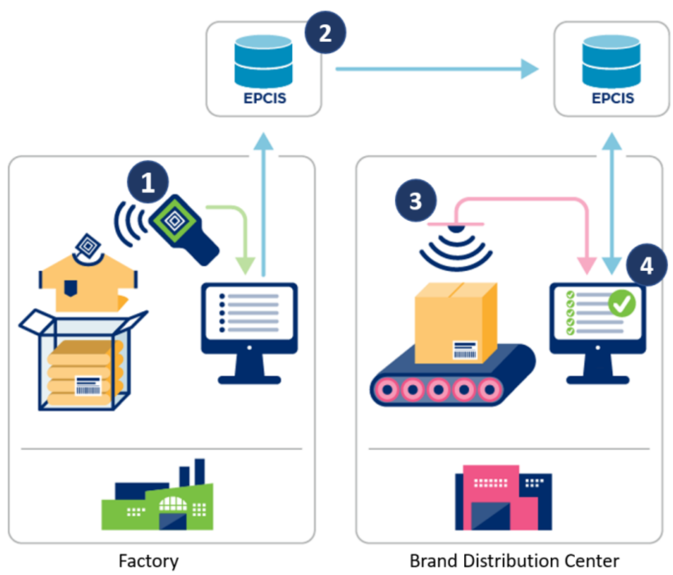
FIGURE 2-2



2.3 Solution Process Steps

The solution design leverages trading partner-provided item-level data to significantly automate and simplify the case/carton inspection process. The process is broken into these steps and is expanded upon in the following sub-sections:

1. As trade items are produced, packed into cases/cartons, and shipped to the brand DC, the factory generates EPCIS events that include the capture of serialized item-level data to specific case/cartons.
2. As events are generated, they are captured to the EPCIS repository of the factory to be available for query by trading partners.
3. The brand DC receives the shipment of cases by reading the item-level RFID tags with readers positioned along the conveyor[4].
4. The brand DC can then utilize EPCIS events queried from the factory's EPCIS repository to compare to RFID read data from along the conveyor to assess which cases could require further auditing.



2.3.1 Step 1: Factory Capture of Item-Level Data

As each item is produced at the factory, an EPC-enabled RFID tag is associated identifying it with a GTIN and a serial number. The items are then combined into fixed count cases/cartons to ready for shipping out to the distribution center of the brand. Each case will cross a factory read station to verify the contents and confirm the factory is fulfilling the customer-provided Pack Plan or Purchase Order.

[4] While this guideline focuses on DC operations with conveyance, a smaller organization may apply the same principles by handling and inspecting individual case/cartons per section 3.1.1.2.

The most important characteristic of the factory data collection solution is that each station location, (each read point), has a single, unique, consistent identifier. This identifier is packaged with the data collected by the station. This allows downstream auditing to establish a credibility score specific to that read point, based on a comparison of expected to read values. The GS1 standard identifier for this is the Global Location Number (GLN). Further information on the GLN is provided in section 9.1.

A key element and benefit of this use case is that each individual item is uniquely identified and scanned. Whereas with a 1D barcode, there is the possibility of double-scanning the same item. These uniquely identified items are then associated with one another and the case/carton.

The core component parts of a factory read station are as follows:

1. *User Interface*: This indicates process status (e.g. if a case/carton is properly packed).
2. *Reader*: This identifies each and every item EPC in the case/carton. This may be an RFID reader (which offers labor savings due to the speed of data collection) or an imager that captures a 2D barcode containing each item GTIN and Serial Number.
3. *Expected Content*: This is based on the customer-provided Pack Plan, if provided, or Purchase Order.
4. *Validation Process*: This ensures proper process integration so that data must be properly collected in order to ship the case/carton.
5. *Label Printer*: This may be used to print the logistic label containing the newly assigned SSCC[5] of the case/carton encoded in a GS1-128 barcode required for shipping.
6. *Data Capture and Share*: This formats the collected data into EPCIS syntax and makes such data available for trading partners. At this point, the case/carton has been confirmed at a factory ready station, an SSCC is assigned and encoded as a part of a logistic label, and the case/carton is shipped to the brand DC.

2.3.2 Step 2: Expressing and Sharing Factory Data with EPCIS

2.3.2.1 The EPCIS Standard

The EPCIS standard was originally conceived as part of a broader effort to enhance collaboration between trading partners by sharing detailed information about physical or digital objects. The name EPCIS reflects the origins of this effort in the development of the Electronic Product Code (EPC). The EPCIS standard applies to situations where visibility event data is captured and shared.

The goal of EPCIS is to enable disparate applications to create and share visibility event data, both within and across enterprises. Ultimately, this sharing is aimed at enabling users to gain a shared view of physical or digital objects within a relevant business context. It helps answer the "what, where, when, and why" questions to meet consumer and regulatory demands for accurate and detailed product information.

The EPCIS standard defines a common data model for visibility event data as well as specifications for expressing the data in syntaxes commonly used for exchanging data between different applications. The standard also defines interfaces for an implementation to both capture EPCIS data and return it in

[5] See section 9.2 for details on SSCC

response to a standardized query. The EPCIS Standard is also accompanied by the Core Business Vocabulary (CBV) which defines a set of standardized vocabulary for populating EPCIS events.

EPCIS data shall align with ASN data. For example, and ASN indicating that a specific carton contains 60 items should correlate to an EPCIS message that delineates 60 items for the same carton.

Examples of EPCIS events are reviewed in detail in section 8.

2.3.2.2 EPCIS Events of the Capture Factory Data

As individual items are produced, RFID with SGTINs are attached, affording the opportunity to capture the Commissioning EPCIS Event. Individual items are packed into case/cartons and the serialized item-level data is captured and associated to the serialized case/carton at a factory Read Station. The station process captures the content of the case/carton and confirms that the factory is fulfilling the Pack Plan or customer Purchase Order. Optionally, the process could also allocate SSCCs for each case/carton following its confirmation. If so, then a label is printed encoding the SSCC in a barcode. Case/cartons may be aggregated into pallets, and an EPCIS 'shipping' event may also be recorded noting which cases or pallets have departed and the date/time of departure.

As each activity occurs, the EPCIS events reflecting them are captured into an EPCIS repository of the factory. This repository stores the event data awaiting queries from trading partners and their applications to request the event data.

The EPCIS standard data model is flexible enough to accommodate the many different permutations in supply chain activities while still expressing a language commonly understood by trading partners and their chosen systems. The foundation to making that common understanding possible are the data dimensions of each EPCIS event. First, each EPCIS event contains identification of the objects that are the focus of the event, the 'What' dimension. Like a snapshot, EPCIS events occur at specific points in time so the date/time in the sequence of activities can be interpreted in the actual order they occurred. Next, events contain identification of the locations at the moment the events occurred as well as where objects are as a result of the event. Finally, events can be associated to a series of other events that give context about the business circumstances of an event or give more description about the condition of the objects in the event. The claims compliance use case depends on these data dimensions working together to provide necessary information to ensure accurate fulfillment of orders.

Currently, factories, brands, and logistics providers rely, predominantly, on the ASN EDI transaction for alerts about product shipments from factories to DCs. As factories implement EPCIS, they need to give special care to ensure that the EPCIS data shared with trading partners does not contradict the ASN data they also share. EPCIS data and ASN data will express data in different ways and likely at different degrees of granularity. For example, an ASN could indicate that the number of items in a specific carton is 60, while an EPCIS message would correlate that information by delineating the 60 SGTINs aggregated to that specific carton.

A hypothetical example of the EPCIS events for the factory data is presented in section 7.3 of this guideline.

2.3.2.3 Facilitating EPCIS Data Exchange

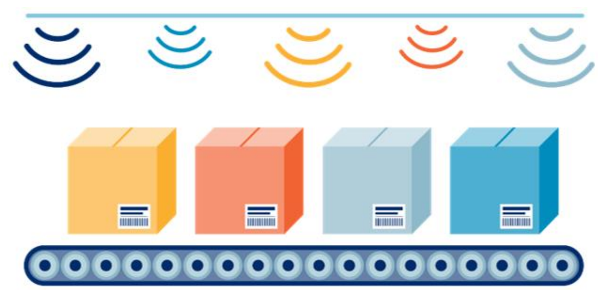
The EPCIS standard envisions events are primarily exchanged via queries between the respective event repositories of trading partners. Specifically, it defines how implementations can utilize common web services (i.e., APIs) to execute and respond to queries. The standard is modular in case different industries or subsets of trading partners choose to exchange EPCIS data with methods more suitable to their specific needs. This guideline will presume that companies wishing to address the claims compliance use case will rely on the query interface for exchanging EPCIS data with trading partners.

To leverage the query interface, implementing companies will need to request information on the chosen EPCIS repositories of their trading partners and test connections. This onboarding process with trading partners will mirror similar processes to establish EDI connections as a part of a new commercial relationship. Additionally, trading partners will need to articulate the relevant core components of the EPCIS data they are requesting, such as the case/carton identifiers (i.e., SSCC). This can be done as part of the workflow for unloading and recording case/cartons received into a facility. The following are considerations for implementing companies to have in mind when establishing a new EPCIS repository or connection to a trading partner's:

- Which version of the EPCIS Standard is supported?
- Which data format is utilized by the repository (e.g., XML, JSON, JSON-LD)?
- What is the Uniform Resource Identifier (URI) of the EPCIS repository for the Capture and Query interfaces?
- What Authorization and Security requirements does the EPCIS repository have or need to have?
- Can the EPCIS repository respond in a reliable and timely enough manner to facilitate the data comparisons described in section 2.3, step 4?

2.3.3 Step 3: DC Conveyor Reads of Item-Level RFID tags

The factory data provided enables content confirmation to occur without depending on isolating and reading each carton, individually. This significantly simplifies the data collection process, lessens the equipment cost, and reduces solution maintenance requirements. With factory-provided data, RFID readers are utilized to determine which cases need exception handling; without the data, DCs need to rely on the RFID readers to capture the encoded identification for each item and associate it to each case/carton.



A redundant set of commercial-off-the-shelf (COTS) RFID readers may be installed along sections of conveyance to capture item-level data. The reader antennas are placed in various opportune locations and at various angles to the conveyor.

RFID is a probabilistic technology. Tag orientation and distance to an antenna, as well as time, are factors determining if a tag is detected. Providing a redundant set of readers affords the tags a significantly higher opportunity to be detected.

Research has shown the viability of the technology to capture this data at line speeds.[6]

2.3.4 Step 4: Comparison of Read to Expected and Decision to Divert for Manual Inspection

The factory-provided data allows DC reads of item RFID tags, that are otherwise not associated with case/cartons, to be logically aligned with case/cartons. In the below example, data for two cartons is provided by the factory. The Distribution Center reader collects the item-level RFID tag values for all the items in the first carton and none of the items in the second carton. Therefore, the DC solution can conclude that the first carton has been received (Carton Shipment Accuracy), and that all the factory-reported items are present for that case/carton (Carton Pack Accuracy).

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[6] The GS1 US Claims Compliance Workgroup, which produced this guideline, included significant participation from the Auburn University RFID Lab. The lab and other workgroup members performed distribution center tests to validate the solution design. The tests demonstrated high read rates (above 98%) with a basic solution employing 4 COTS readers. Randomly checked factory scan-pack data was confirmed to be completely accurate, and the conveyor readers were able to read sufficient data to confirm the solution design.

	Factory-Provided Data (abridged)		Distribution Center Data (abridged)
	Case/Carton (SSCC)	Item Identifier (SGTIN)	Item Identifier (EPC)
All items match	sscc:0614141.0000000001	sgtin:0614141.107346.0017	sgtin:0614141.107346.0017
	sscc:0614141.0000000001	sgtin:0614141.107346.0018	sgtin:0614141.107346.0018
	sscc:0614141.0000000001	sgtin:0614141.107346.0019	sgtin:0614141.107346.0019
	sscc:0614141.0000000001	sgtin:0614141.107346.0020	sgtin:0614141.107346.0020
	sscc:0614141.0000000001	sgtin:0614141.107346.0021	sgtin:0614141.107346.0021
No items match	sscc:0614141.0000000002	sgtin:0614141.199999.2200	Not Read
	sscc:0614141.0000000002	sgtin:0614141.199999.2201	Not Read
	sscc:0614141.0000000002	sgtin:0614141.199999.2202	Not Read

Research has shown that using a redundant set of COTS readers results in a very high percentage of tag reads.[7] Product packing characteristics and product types will impact the read results. For example, footwear will read at or near 100%, as packed shoeboxes space tags out and contain relatively few tags per case/carton. Whereas a case/carton of socks may contain over 100 tagged items and be very densely packed. For this reason, the solution design anticipates the possibility of missing a very small percentage of the RFID tags. In the below example, one item-level tag is not read, which requires a systemic or algorithmically based decision to be made to divert that case/carton for inspection.

	Factory-Provided Data (abridged)		Distribution Center Data (abridged)
	Case/Carton (SSCC)	Item Identifier (SGTIN)	Item Identifier (EPC)
	sscc:0614141.0000000001	sgtin:0614141.107346.0017	sgtin:0614141.107346.0017
	sscc:0614141.0000000001	sgtin:0614141.107346.0018	sgtin:0614141.107346.0018
	sscc:0614141.0000000001	sgtin:0614141.107346.0019	sgtin:0614141.107346.0019
	sscc:0614141.0000000001	sgtin:0614141.107346.0020	sgtin:0614141.107346.0020
	sscc:0614141.0000000001	sgtin:0614141.107346.0021	sgtin:0614141.107346.0021
	sscc:0614141.0000000001	sgtin:0614141.107346.0022	sgtin:0614141.107346.0022
Missing Item	sscc:0614141.0000000001	sgtin:0614141.107346.0023	Not Read
	sscc:0614141.0000000001	sgtin:0614141.107346.0024	sgtin:0614141.107346.0024

The decision to divert the above carton may be based on factors such as:

- The individual item value (sales price)
- The effort to inspect (how easy is it to audit the case/carton)
- The likelihood of shrink (is the item in a high-shrink category)
- Business sensitivity to item shortage (is it an integral part of a collection)
- Factory read point reputation

One of the most helpful inputs to the decision to divert is the factory read point reputation, as expressed in the historical comparison of data specifically provided by that read point. If, for example, all prior manual inspections of case/cartons from a specific factory read point have confirmed the data provided by the factory solution, then a high degree of confidence can factor into the decision. If there

[7] IBID

is limited history for a factory read point, then the action of diverting and inspecting can help to further establish the reputability of the factory reader data.

This approach allows the DC to automate the inspection of Carton Pack Accuracy. Based on the prior-referenced research, all expected items will be confirmed for the vast majority of case/cartons. Of the cartons where items are missed, the cartons with the greatest number of missing tags may be diverted for manual inspection. This moves the DC from a random inspection to a targeted inspection paradigm. The results of the manual inspection are then used to inform the reputation of the source reader and clarify category-level read performance, making the solution more intelligent over time.

See section 3.1.1.2 for information regarding the manual inspection process.

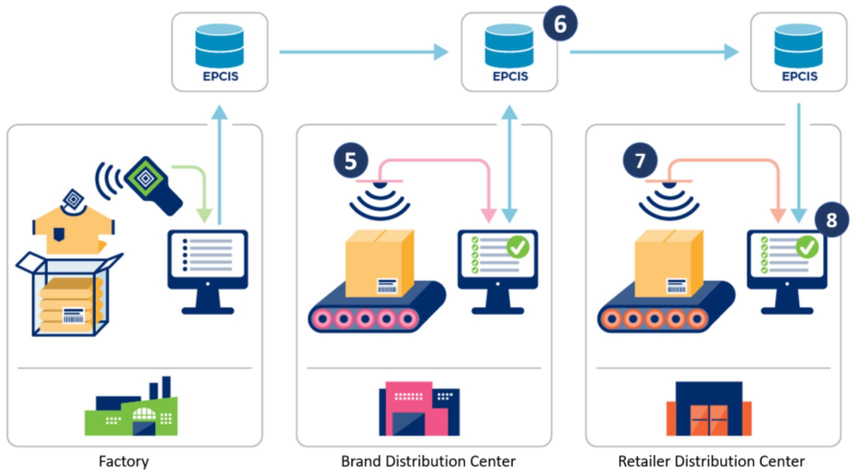
3 Solution Design: Brand to Retailer

The brand-to-retailer design extends the factory-to-brand solution design forward to the retailer DC. It leverages the same process; that of leveraging trading partner data to simplify Carton Shipment Accuracy and Carton Pack Accuracy audits.

The process will differ for cross-docked and repacked case/cartons. The process follows and is expanded upon in the following sub-sections:

See section 2.3 for factory-to-brand steps 1-4.

5. Brand DC collects item-level data.
6. Brand DC structures the data in EPCIS format and makes this available to the retailer.
7. The retailer DC reads the item-level RFID data at line speed.
8. The retailer DC systems compare expected and actual reads, assessing the need for further auditing.



3.1.1 Step 5: Brand DC Collects Item-Level Data

Brand DC data collection, used for the purpose of sharing with the retailer, will be different for cross-docked and repacked case/cartons.

- Cross-docked case/cartons are validated inbound by leveraging factory scan/pack data. This may be re-confirmed in an outbound scan.
- Repacked case/carton content is captured during or immediately after pick-pack.

3.1.1.1 Cross-Docked Case/Carton Data Capture

Conveyed cross-docked case/cartons are read in the brand DC per step 3 in section 2.3 and section 2.3.3. This same data may be shared with the retailer DC. Three comparison possibilities follow for any given case/carton:

a. The brand DC conveyor solution reads all factory-reported tags
b. The brand DC conveyor solution reads most factory-reported tags and does not divert for inspection (per section 2.3.4). In this case, an inference is made that the unread items are present.
c. The brand DC conveyor solution reads factory-reported tags and diverts for inspection. The resulting inspection data may be shared with the retailer DC.

3.1.1.2 Manually Inspected Case/Carton Data Capture

Data captured from case/cartons that are manually inspected (e.g., diverted cross-docked case/cartons) may be shared with the retailer in like fashion as factory data was shared with the brand. (As stated above, such data may also be used to communicate audit results with the factory, as the basis for vendor "score carding" and claims and chargeback discussions.) See section 2.3.1 for use case components.

The data capture mechanism at this station will collect serialized item-level data. This may be performed via a fixed RFID reader, a handheld RFID reader, and/or an optical scanner (in the event that item-level serialized data is captured in a 2D barcode). The form factor of the data capture mechanism, as well as the unique read station identifier, will be a part of the audit record. Details on how to structure audit data is found in section 8.3.5.

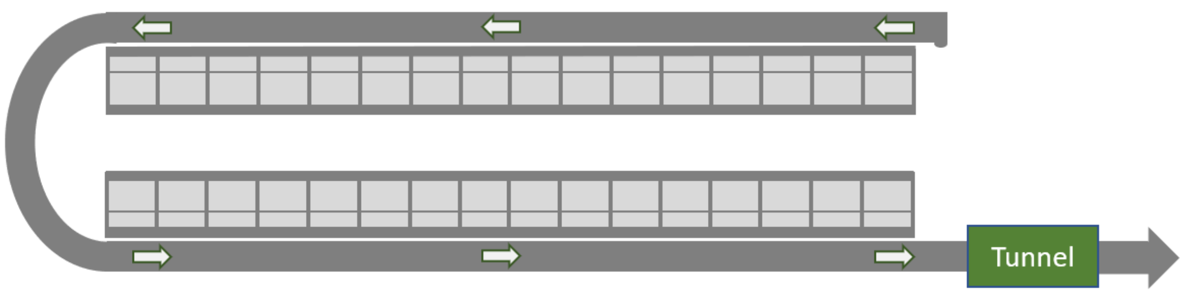
Of course, manual auditing will reveal a number of case/cartons that do not match the pack plan and/or ASN. A discourse on the Failure Modes and Effects Analysis (FMEA) is found in sections 5.2 and 9.3.

3.1.1.3 Repacked Case/Carton Data Capture

Section 2.3.1 describes factory capture of item-level data associated with case/cartons. This same use case may be employed in distribution centers for repacked (as well as manually inspected) case/cartons. This use case is applied where a relatively small number of pack stations are used.

If larger scale operations are in place, a pack tunnel may be a helpful option. This allows a single tunnel to capture data for a plurality of pack-stations. **FIGURE 3-1** shows how a single tunnel may be used to capture data from 32 pack stations.

FIGURE 3-1



Pack tunnel use case details are listed in section 4.1.3, however, it should be noted that this use case requires a relatively slow conveyor speed and a relatively long distance between case/cartons. It is critical that the tunnel have ample opportunity (time) to read the packed items and ample ability to ensure association of tags to the right case/carton (spacing).

3.1.2 Step 6: Brand DC Shares Data with Retailer

The same process described in section 2.3.2 applies here, using brand DC read events (instead of factory read events). In some instances, the brand will infer the presence of product that was not read (per 3.1.1.1.b). Explanation and examples of this are found in sections 8.3.2 and 8.3.4.

As previously stated, EPCIS data should align with ASN data. For example, an ASN indicating that a specific carton contains 60 items should correlate to an EPCIS message that delineates 60 items for the same carton. Manual audit results that reveal a divergence from the ASN data should result in either the case/carton content adjusted to match the ASN, or the ASN adjusted to match the case/carton content.

Important: Manual audit results that reveal a divergence from the ASN data should result in either the case/carton content adjusted to match the ASN, or the ASN adjusted to match the case/carton content.

3.1.3 Step 7: Retailer DC Reads the Item-Level RFID Data at Line Speed

The same process described in section 2.3.3 applies here, noting that it leverages brand DC-provided data and not factory-provided data. If a brand wishes to share factory level data, it may choose to do so. The details on how to communicate this are included in section 8.

3.1.4 Step 8: Retailer DC Systems Compare Expected and Actual Reads

The same process described in section 2.3.4 applies here. If the decision to divert a case/carton is made, the same audit process described in section 3.1.1.2 applies.

4 Use Cases

For the purposes of this document, the term "Use Case" describes any specific process (such as packing, inspecting, or receiving) that is automated or enhanced using RFID technology. A use case includes a data collection device, items being evaluated, a location, and a process step. Sections 2.3.1 and 2.3.3 defined elements of factory packing/inspection and DC conveyor-based inspection of inbound case/cartons, respectively.

4.1 Requirements for all Use Cases

- The use case data collection read point must be identified with a single, consistent, globally unique, identifier. The Global Location Number (GLN) is part of the GS1 system of standards and is used to do just this. Every use case necessitates identifying each location, with a GLN, where RFID readers will be employed. As noted previously, the location where events occur is a part of each EPCIS event and is identified by a GLN. With EPCIS data exchange, the reliability and accuracy of the RFID readers where the events occur may be assessed by trade partners. Information on how to obtain a GLN is found in section 9.1.
- The items read by the data collection device must also be uniquely identified using GS1 Standards, as mentioned in section 1.2. This relates to the use of GS1 Standard barcodes on case/cartons as well as the use of EPC/RFID tags on products.
- Use cases should be part of a repeatable, error-proof process that is incorporated into core business processes and systems.

4.1.1 Factory or DC Pack Stations

Section 2.3.1 outlines this for factories, and sections 3.1.1.2 and 3.1.1.3 outlines this for distribution centers. These use cases capture specific item-level EPC values and associate them with individual case/cartons. These occur either while the case/carton is being packed, or as part of an inspection of items packed onsite prior to shipment.

Where ASNs are used to describe the count of GTINs included in specific cartons, the ASN count of GTINs needs to match the corresponding count of item EPCs. For example, **FIGURE 2-1** (in section 2.3.4) shows that the case/carton identified with SSCC:0614141.0000000001 has 5 items, all with the same specific GTIN. An accurate ASN would mirror this by indicating the same quantity of GTINs.

4.1.2 DC Inspection Station

This use case is similar to the factory or DC pack station with the addition of the ability to leverage previously collected item-level EPC data to assess Case Pack Accuracy. An inspection station may also be equipped with a printer (as in the case when source tagging is just beginning and an inventory of items in transit or in storage may need to be tagged). Where inspected cartons do not match the ASN or Pack Plan, possible discrepancies are detailed in Section 9.3*.* A means of documenting inspection results is indicated in section 8.3.5. Using a standard syntax to record and share inspection results enables systemic solutions to streamline the analysis and sharing of inspection results.

4.1.3 DC Pack Tunnel

See section 3.1.1.3. for an introduction to this use case. A DC Pack Tunnel may be used in place of a plurality of pack stations under certain conditions. The tunnel solution must be designed to ensure a error-proof means of reading case/carton content. This includes the following features:

- Case/cartons are scanned upon entry into the tunnel in order to correlate expected content (based on the WMS case/carton expected content) to RFID reads.

- A case/carton-spacing mechanism is employed to ensure adequate distance so that items are not mistakenly associated with the wrong case/carton.
- The conveyor should be of a sufficient speed to ensure adequate time to read all packed items.
- An RFID read of item-level content that does not match the WMS expected GTIN quantities will result in that case/carton being diverted for inspection.
- As with the inspection and pack station use case, ASN carton-level product quantities should match the item-level RFID data captured.

4.1.4 DC Conveyor Inspection

See section 2.3.3 for an introduction to this use case. A plurality of fixed RFID readers is placed at opportune locations along a conveyor to capture item-level EPC data.

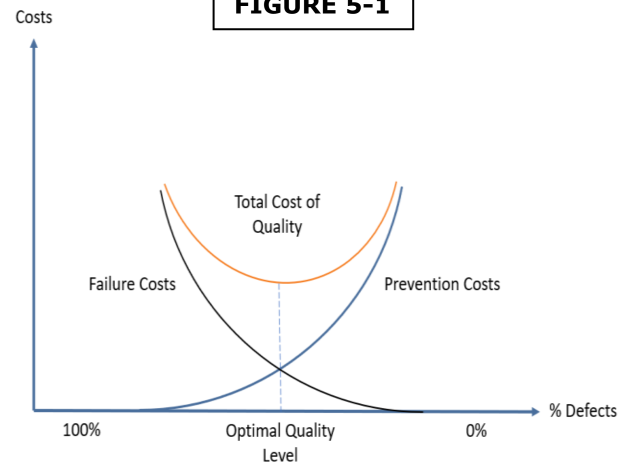
From a data representation perspective, the group of readers used to capture the item-level data shall be grouped as a whole, as they collectively capture tag data. For example, a set of four readers may be used to capture such data. Each reader may read 90% of the tags, and when combined, they collectively have read as much as 100% of the tags. Because the data is combined, the readers are also combined into a single Business Location GLN.

However, given the potential for spreading readers through multiple areas of a distribution center, it may be advantageous to capture specific reader identities for DC internal use to gain insight into product flow and throughput. Therefore, the individual reader locations are tracked as specific Read Point GLNs. A single Business Location GLN may have multiple Read Point GLNs.

5 Quality Audits

Case Pack Inaccuracy is a product quality issue. The cost of quality is composed of the sum of two factors: Prevention Costs and Failure Costs. Prevention costs are costs associated with avoiding poor quality, and failure costs are the costs incurred from either the error correction or the error impact. A minimal number of resources used on poor quality prevention will yield high failure costs, while an effort to eliminate every failure will generally yield very high prevention costs. As is seen in **FIGURE 5-1**, an optimal level of quality is met when the sum of both is at a minimum. This guideline provides a means of lowering the prevention costs by enabling the easier detection of quality issues. This is brought about by moving from undirected manual audits to directed case/carton audits. This shifts the optimal quality level rightward, moving closer to 0% defects.

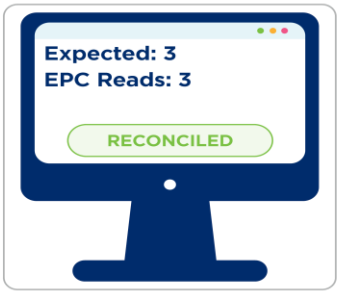
FIGURE 5-1



5.1 Manual Audit Findings

Manual case/carton audits compare the vendor-reported (expected) content to the audit station (EPC read) data. Such audits have possible outcomes where expected is either equal to, greater than, or less than EPC reads. Considerations and possible outcomes for these possible cases follow.

5.1.1 Expected Equals EPC Reads

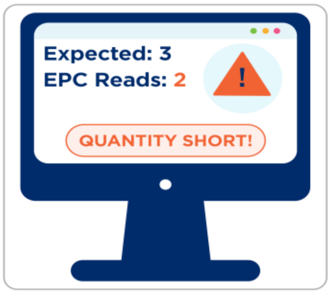


Possible findings:

1. The EPC read quantity, expected quantity, and actual quantity are all equal. The case is accurately packed.
2. Extra Untagged Item(s) Present: An extra item without an RFID tag is included in the case, so it will not be detected on scanning.
3. Tag Present without Item: RFID Tag is present in the box, but its corresponding item is not present.

5.1.2 Expected Greater than EPC Reads

EPC Scan is less than expected quantity for a particular GTIN



Possible findings:

1. Item under picked: The quantity of items and matching EPCs are less than expected, causing a particular GTIN to read short.
2. Non-performing tag: Tags that are either weak or damaged, causing them to not be read.

3. Untagged item: An item is not tagged with an RFID tag.

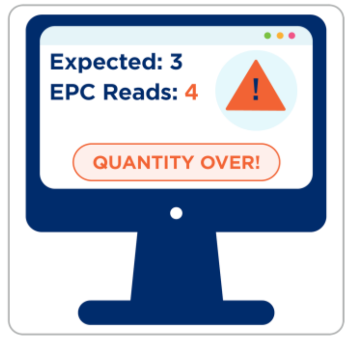
4. Unencoded/Mis-encoded item: The tag was either not encoded correctly, or not encoded at all.

5. Duplicate EPC Values: Two RFID tags having the same EPC number, causing the reader to capture only one of the two tags.

5.1.3 Expected Less than EPC Reads

EPC Scan is greater than expected quantity for a particular GTIN

Possible findings:



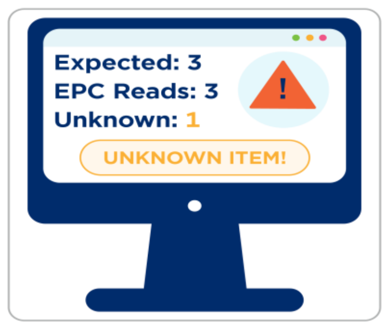
1. Item over picked: The quantity of items and matching EPCs are greater than the expected, causing a particular GTIN (or SKU) to read long.

2. Multiple tags on one item: One item tagged with multiple RFID tags.

3. Extra Tag in Carton: Extra tag is present in carton, but not attached to any product.

4. Environmental tag read: Tags near (but not in) the carton being read.

5.1.4 Unknown Items



EPC Scan reveals unknown items

Possible findings:

1. Unknown Item in Carton – Valid EPC, but an unknown item in the case whose GTIN is not included in order.

2. Unencoded/Misencoded item – The tag was either not encoded correctly or not encoded at all.

5.2 Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a powerful tool that can help prioritize failure resolution based on the risk that each failure possesses. For performing FMEA, three factors are determined for each failure mode, namely, Severity (S), Occurrence (O), and Manual Detection and Resolution (D), each rated on a scale of 1-10. Severity can be calculated on the basis of whether a particular failure can lead to a claim, chargeback, or other costs of failures. A higher severity rating would mean a higher cost of failure. Occurrence describes the probability of failure appearance. Occurrence can be determined by auditing the case/cartons and determining the occurrence rate of each failure type per 100 case/cartons. Manual Detection and Resolution is defined as the ability to detect and resolve the failure before it reaches the customer. A high detection number indicates that the chances of detection are low and/or it is very difficult to resolve the failure. This will be followed by calculating the Risk Priority

Number (RPN), which is the multiplication of the three factors: RPN = S x O x D. Thereafter, it will be noted which failures are having a high RPN. Companies can then set a threshold RPN and take the necessary measures to reduce the RPN for each failure below its threshold level.

5.2.1 Failure Resolution

In the Failure Resolution phase, an organization can utilize standardized Corrective Actions or perform a Root Cause Analysis and implement Preventive Actions. Corrective Actions are reactive measures taken to resolve an immediate problem but do not ensure the same issue does not arise again. Preventive Actions are proactive measures taken to ensure a potential failure does not occur in the first place. The two can be used in conjunction to effectively minimize failure occurrences, while efficiently resolving errors that occur. The intent of this guideline is to ultimately provide the tools to facilitate preventative actions. A key enabler of this is that details pertaining to the pack station (such as the location, date/time, and items) allow for a precise understanding of when and where a quality issue occurred. An ongoing cycle of detection and correction helps drive the supply chain collectively toward greater inventory accuracy.

Case/carton Pack Accuracy errors may be attributed to either RFID Compliance (e.g. missing or broken tag) and Inventory Compliance (e.g. missing item) errors. RFID compliance errors are seldom cause for a claim or chargeback, leading retailers to prioritize remediation of inventory compliance errors. As RFID compliance programs continue to be implemented by retailers, RFID compliance may be enforced with stricter measures.

6 Implementation Guidance

6.1 Glide Path for Staged Adoption

Solution implementation can be staged to ensure solution confidence as the business expands use in successive stages. The following offers a general progression that may be used for solution exploration and project planning. Solution partners may be able to accelerate this process by providing a scalable turn-key solution up front.

1. **Brand Owner – Lab Test:**

   Brand owners may be surprised to find that certain factories already have processes in place to capture item-level data associated with case/cartons. This may be the case where specific solution providers are already servicing factories and providing such functionality. In this event, a basic first step is to leverage an RFID reader to manually compare case/carton item-level data. Such a comparison (between factory-reported item-to-case/carton data and DC-audited data using an RFID reader) does not require system integration and can serve to drive confidence in the viability of the factory-provided data and understanding of the RFID technology. If a brand owner does not have a factory with an existing scan-pack data collection process (as described in section 2.3.1), the brand owner may benefit from evaluating via demonstration or other hands-on lab experience.

2. **Brand Owner – Limited Manual Inbound Inspection:**

   Once the brand owner has identified one or many source factories that can provide item-to-case/carton data, the brand owner can either engage a solution provider or develop in-house expertise to install several conveyor-based RFID readers. The solution initially is merely capturing tag reads for manual evaluation and is not integrated into production processes. A comparison of automatically collected conveyor-based item-level data and manually audited case/cartons ensues. This demonstrates the solution viability before having invested in system integration.

3. **Brand Owner – System Integrated Inbound Inspection:**

   At this stage, the brand owner has made the decision to invest in an integrated solution that consumes EPCIS-structured data from factories, evaluates DC conveyor-based RFID data, and moves from random inspection to targeted inspection of case/cartons. The brand owner has also established a plan for factory data to be collected and provided. An algorithm is developed to determine which case/cartons to divert for inspection. Results of manual inspection and conveyor-based reads further informs the algorithm, which also accounts for product category and source factory GLN historical accuracy.

4. **Brand Owner – Repacked Case/Cartons Outbound Inspection**

   The solution to this point provides automatically audited Brand DC inbound receiving. For cross-docked (a.k.a. full-case picked) cartons, the same inbound audit check ensures the expected items are flowing outbound to the retailer. For repacked case/cartons, an additional data collection step is added to capture repacked item-to-case/carton data as described in section 3.1.1.

5. **Solution Extension to Retailer**

   At this point, the brand has established confidence in cross-docked and repacked case carton data and is ready to share the same with the Retailer. The retailer is now able to perform similar automated inbound audit steps following steps 1,2, and 3 above.

6.2 Best Practices for Internal Testing

Initial solution testing for each use case, regardless of location, will include a set of tests with tagged products in case/cartons. Such acceptance testing is standard for project deployments. Such testing should include a set of tagged items for every product category in order to confirm performance. It is recommended to keep the test cartons used (that include tagged product) in storage for future tests. This allows for re-checking the solution at a later date using the same set of test materials.

Additional data to capture for change management purposes include:

- Conveyor speed (if applicable)
- Environmental changes (e.g., placement of ladders, shielding material, etc.)
- Antenna placement, blockage and tilt
- Reader settings, firmware version

6.3 Tools for Root Cause Analysis

A benefit of the collected data is that issues with case/cartons that do not relate to case/carton pack accuracy (e.g., items are damaged or have been packed incorrectly) can be researched to find the specific place and date/time where the case/carton was last inspected. This can be a helpful way to understand root-cause-analysis and respond with corrective action.

6.4 Solution Provider Capabilities

Solution providers can offer a wealth of expertise and experience to provide prescriptive guidance to catalyze solution development. Solution providers should have the following core capabilities:

- Experience with RFID technology in the given industry
- Experience with the use cases being deployed
- Understanding of RFID reader settings, such as dense reader mode, tag sessions, and various power settings
- Understanding of ideal antenna types and placement considering various orientations of packed tags
- Understanding and incorporation of GS1 standards, specifically GTIN, EPC, and EPCIS standards. This includes the ability to provide and consume EPCIS event data. This helps to provide an open solution and avoid vendor lock.
- Project management and support capabilities aligned with business requirements and deployed locations
- Appropriate reporting to drive claims reconciliation discussions
- Ability to detect and report on duplicate EPCs in partner-provided messages

7 Business Reconciliation

There are various types of data shared between trade partners:

- *Operational Data*: This is systemically shared transactional data providing insights into shipments. It includes ASN EDI information that relates to case/carton identifiers, as well as EPCIS event data that describes item-level identifiers in case/cartons. Such data enables trading partners to automate the auditing of case/carton pack accuracy.

- *Audit Data*: This is the data collected by trading partners when manually auditing case/carton pack accuracy and is the basis for claims.

- *Business Reconciliation Data*: This is the data processed into information that is used to aid trading partners in the timely resolution of claims and chargebacks. This includes references to the Operational and Audit Data, as well as other data such as Purchase Order and/or Load Plan details.

Business Reconciliation Data synthesizes the various sources of data to clarify the following:

- What configuration of products were supposed to be in each case/carton according to customer expectations?
- What specific items were recorded as packed in each case/carton according to the supplier's outbound packing/inspecting process?
- What specific items were recorded as confirmed present in each case/carton according to the customer's inbound inspection process?

By systemizing the capture and share of this item-level data, trading partners can track specific items at specific locations at specific times to bring clarity and help align understanding of claims. This facilitates an expedited and automated path toward trading partner alignment and the resolution of claims disputes.

8 Data Sharing with EPCIS

8.1 EPCIS

The EPCIS standard was originally conceived as part of a broader effort to enhance collaboration between trading partners by sharing detailed information about physical or digital objects. The name EPCIS reflects the origins of this effort in the development of the Electronic Product Code (EPC). It should be noted, however, that EPCIS does not require the use of Electronic Product Codes or Radio-Frequency Identification (RFID) data carriers, and as of EPCIS 1.2, it does not even require instance-level identification (for which the Electronic Product Code was originally designed). The EPCIS standard applies to situations in which visibility event data is to be captured and shared, and the presence of "EPC" within the name is of historical significance only.

The goal of EPCIS is to enable disparate applications to create and share visibility event data, both within and across enterprises. Ultimately, this sharing is aimed at enabling users to gain a shared view of physical or digital objects within a relevant business context. It helps answer the "what, where, when, and why" questions to meet consumer and regulatory demands for accurate and detailed product information.

8.2 EPCIS and CBV Standards Resources

- **EPCIS and CBV Standards** - *https://www.gs1.org/standards/*
  - The core EPCIS standard document and artifacts for supporting implementations are found on this page. The core document includes definitions of EPCIS event data, bindings to data formats (e.g., XML, JSON, JSON-LD), and specifications on the query/capture interfaces. The Service Layer section is a key starting point for understanding the structure and key considerations for an EPCIS query.
  - Alongside the core EPCIS standard document is the Core Business Vocabulary (CBV), a companion standard defining vocabulary to populate the fields of an EPCIS event. This includes details on formatting identifiers and standard code values to use within an event.

- **EPCIS and CBV Implementation Guideline** - *https://www.gs1.org/standards/epcis-and-cbv-implementation-guideline/current-standard*
  - This is the core guidance document for implementing the EPCIS and CBV standard, which includes specifics on topics like modeling events and EPCIS queries. This is a great place to start for users that are new to the EPCIS standard and helpful to read in conjunction with the core standards documents.

- **Implementation Support Tools**
  - EPCIS Workbench - *https://epcisworkbench.gs1.org/*
    - The EPCIS Workbench is a free, interactive tool for working with the EPCIS standard. Users can generate EPCIS event data as well as capture and query the data with EPCIS repositories.
  - FreEPCIS - *https://freepcis.gs1.org/ui/home*
    - FREEPCIS is a free EPCIS repository for development and testing. Events can be received via the capture interface and stored in a persistent repository, available for sharing via the query interface. Limited to storing 25 events, the tool is helpful for testing new implementations of EPCIS software and connects easily to EPCIS Workbench accounts.
  - EPCIS Sandbox - *https://ref.gs1.org/tools/epcis-sandbox/*
    - The EPCIS Sandbox tool can be used to make example events as well as convert between previous formats to 2.0 JSON.
  - EPCIS transformation tool - *https://ref.gs1.org/tools/epcis/xsl/*
    - This is an EPCIS transformation toolset that can be used for version 1.2 to 2.0 validation.

- Additional technical files - https://ref.gs1.org/standards/epcis/artefacts
  - This provides relevant technical files used for EPCIS implementation, including the standard itself, JSON API files, and schemas.

8.3 Data Sharing Examples: EPCIS Events

This section provides a handful of examples for EPCIS events illustrating the data which could be provided by the factory and brand DC to their downstream trading partners.

8.3.1 Factory-Provided Data (full-case pack)

The following example illustrates what a factory might provide to the brand for the product packed and shipped to a distribution center. This example assumes the factory was able to read each of the RFID tags attached to the individual items shipped. The data reflects the assignment of GTINs + Serial numbers for each individual item, a SSCC for the case, packing the individual items into the case, and shipping out the case from the factory.


```
{
    "@context": [
      "https://ref.gs1.org/standards/epcis/2.0.0/epcis-context.jsonld"
    ],
    "type": "EPCISDocument",
    "schemaVersion": "2.0",
    "creationDate": "2022-03-01T13:31:21.170Z",
    "epcisBody": {
      "eventList": [
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:23:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sgtin:0614141.000000.11111",
            "urn:epc:id:sgtin:0614141.000000.22222",
            "urn:epc:id:sgtin:0614141.000000.33333",
            "urn:epc:id:sgtin:0614141.000000.44444",
            "urn:epc:id:sgtin:0614141.000000.55555",
            "urn:epc:id:sgtin:0614141.000000.66666",
            "urn:epc:id:sgtin:0614141.000000.77777",
            "urn:epc:id:sgtin:0614141.000000.88888",
            "urn:epc:id:sgtin:0614141.000000.99999",
            "urn:epc:id:sgtin:0614141.000000.12121"
          ],
          "action": "ADD",
          "bizStep": "commissioning",
          "disposition": "active",
          "readPoint": {
```



```
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      },
      "bizTransactionList": [
        {
          "type": "po",
          "bizTransaction": "urn:epcglobal:cbv:bt:0614141000012:XYZ987"
        }
      ]
    },
    {
      "type": "ObjectEvent",
      "eventTime": "2022-03-01T08:24:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "epcList": [
        "urn:epc:id:sscc:0812345002.0000000"
      ],
      "action": "ADD",
      "bizStep": "commissioning",
      "disposition": "active",
      "readPoint": {
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      }
    },
    {
      "type": "AggregationEvent",
      "eventTime": "2022-03-01T08:29:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "parentID": "urn:epc:id:sscc:0812345002.0000000",
      "childEPCs": [
        "urn:epc:id:sgtin:0614141.000000.11111",
        "urn:epc:id:sgtin:0614141.000000.22222",
        "urn:epc:id:sgtin:0614141.000000.33333",
        "urn:epc:id:sgtin:0614141.000000.44444",
        "urn:epc:id:sgtin:0614141.000000.55555",
        "urn:epc:id:sgtin:0614141.000000.66666",
        "urn:epc:id:sgtin:0614141.000000.77777",
        "urn:epc:id:sgtin:0614141.000000.88888",
        "urn:epc:id:sgtin:0614141.000000.99999",
        "urn:epc:id:sgtin:0614141.000000.12121"
      ],
      "action": "ADD",
      "bizStep": "packing",
      "disposition": "in_progress",
      "readPoint": {
```

```json
            "id": "urn:epc:id:sgln:0812345002.00.20202"
          }
        },
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:35:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sscc:0812345002.0000000"
          ],
          "action": "OBSERVE",
          "bizStep": "shipping",
          "disposition": "in_transit",
          "readPoint": {
            "id": "urn:epc:id:sgln:0812345002.00.0"
          },
          "bizTransactionList": [
            {
              "type": "desadv",
              "bizTransaction": "urn:epcglobal:cbv:bt:0812345002003:ABC1234"
            }
          ],
          "destinationList": [
            {
              "type": "location",
              "destination": "urn:epc:id:sgln:0614141.00001.0"
            }
          ]
        }
      ]
    }
  }
```

8.3.2 Brand-Provided Data (full-case pack)

The following example illustrates what a brand might record and provide to the retailer for product received at a distribution center. This example assumes the brand was able to read each of the RFID tags attached to the individual items as the cases are received. Along with this data, the brand could also relay the factory-provided data so the retailer can have a more extensive history of the items. This example shows both the factory data and brand DC data within a single document.

If necessary, the brand could hide portions of the data to avoid revealing sensitive business information. For example, the brand may consider the identity of the factory sensitive and chooses to redact the GLN of the factory from the data relayed to the retailer. The EPCIS standard and implementation guideline offer key considerations for providing access to a subset of information (see section on Authorization in the EPCIS Standard and section on Redaction of EPCIS Event Data in the Implementation Guideline).


```
{
    "@context": [
      "https://ref.gs1.org/standards/epcis/2.0.0/epcis-context.jsonld"
    ],
    "type": "EPCISDocument",
    "schemaVersion": "2.0",
    "creationDate": "2022-03-01T13:31:21.170Z",
    "epcisBody": {
      "eventList": [
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:23:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sgtin:0614141.000000.11111",
            "urn:epc:id:sgtin:0614141.000000.22222",
            "urn:epc:id:sgtin:0614141.000000.33333",
            "urn:epc:id:sgtin:0614141.000000.44444",
            "urn:epc:id:sgtin:0614141.000000.55555",
            "urn:epc:id:sgtin:0614141.000000.66666",
            "urn:epc:id:sgtin:0614141.000000.77777",
            "urn:epc:id:sgtin:0614141.000000.88888",
            "urn:epc:id:sgtin:0614141.000000.99999",
            "urn:epc:id:sgtin:0614141.000000.12121"
          ],
          "action": "ADD",
          "bizStep": "commissioning",
          "disposition": "active",
          "readPoint": {
            "id": "urn:epc:id:sgln:0812345002.00.20202"
          },
          "bizTransactionList": [
            {
              "type": "po",
              "bizTransaction": "urn:epcglobal:cbv:bt:0614141000012:XYZ987"
            }
          ]
        },
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:24:00-05:00",
```



```
      "eventTimeZoneOffset": "-05:00",
      "epcList": [
        "urn:epc:id:sscc:0812345002.0000000"
      ],
      "action": "ADD",
      "bizStep": "commissioning",
      "disposition": "active",
      "readPoint": {
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      }
    },
    {
      "type": "AggregationEvent",
      "eventTime": "2022-03-01T08:29:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "parentID": "urn:epc:id:sscc:0812345002.0000000",
      "childEPCs": [
        "urn:epc:id:sgtin:0614141.000000.11111",
        "urn:epc:id:sgtin:0614141.000000.22222",
        "urn:epc:id:sgtin:0614141.000000.33333",
        "urn:epc:id:sgtin:0614141.000000.44444",
        "urn:epc:id:sgtin:0614141.000000.55555",
        "urn:epc:id:sgtin:0614141.000000.66666",
        "urn:epc:id:sgtin:0614141.000000.77777",
        "urn:epc:id:sgtin:0614141.000000.88888",
        "urn:epc:id:sgtin:0614141.000000.99999",
        "urn:epc:id:sgtin:0614141.000000.12121"
      ],
      "action": "ADD",
      "bizStep": "packing",
      "disposition": "in_progress",
      "readPoint": {
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      }
    },
    {
      "type": "ObjectEvent",
      "eventTime": "2022-03-01T08:35:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "epcList": [
        "urn:epc:id:sscc:0812345002.0000000"
      ],
      "action": "OBSERVE",
      "bizStep": "shipping",
```



```
        "disposition": "in_transit",
        "readPoint": {
          "id": "urn:epc:id:sgln:0812345002.00.0"
        },
        "bizTransactionList": [
          {
            "type": "desadv",
            "bizTransaction": "urn:epcglobal:cbv:bt:0812345002003:ABC1234"
          }
        ],
        "destinationList": [
          {
            "type": "location",
            "destination": "urn:epc:id:sgln:0614141.00001.0"
          }
        ]
      },
      {
        "type": "ObjectEvent",
        "eventTime": "2022-03-01T20:15:00-06:00",
        "eventTimeZoneOffset": "-06:00",
        "epcList": [
          "urn:epc:id:sscc:0812345002.0000000",
          "urn:epc:id:sgtin:0614141.000000.11111",
          "urn:epc:id:sgtin:0614141.000000.22222",
          "urn:epc:id:sgtin:0614141.000000.33333",
          "urn:epc:id:sgtin:0614141.000000.44444",
          "urn:epc:id:sgtin:0614141.000000.55555",
          "urn:epc:id:sgtin:0614141.000000.66666",
          "urn:epc:id:sgtin:0614141.000000.77777",
          "urn:epc:id:sgtin:0614141.000000.88888",
          "urn:epc:id:sgtin:0614141.000000.99999",
          "urn:epc:id:sgtin:0614141.000000.12121"
        ],
        "action": "OBSERVE",
        "bizStep": "receiving",
        "disposition": "in_progress",
        "readPoint": {
          "id": "urn:epc:id:sgln:0614141.00001.32323"
        },
        "bizLocation": {
          "id": "urn:epc:id:sgln:0614141.00001.0"
        }
      }
```

```
      ]
    }
  }
```

8.3.3 Factory-Provided Data (case with 1 RFID tag not read)

This example is the same as the previous factory-provided data example except that the factory did not read the RFID tags for one of the individual items. The factory was able to confirm the presence of the tenth item but unable to provide the GTIN + serial number of the attached RFID tag. This tenth item is represented by its GTIN and a quantity but no serial number. The serial number of the item that goes unread was 55555 in the previous factory provided data example.


```
{
    "@context": [
      "https://ref.gs1.org/standards/epcis/2.0.0/epcis-context.jsonld"
    ],
    "type": "EPCISDocument",
    "schemaVersion": "2.0",
    "creationDate": "2022-03-01T13:31:21.170Z",
    "epcisBody": {
      "eventList": [
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:23:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sgtin:0614141.000000.11111",
            "urn:epc:id:sgtin:0614141.000000.22222",
            "urn:epc:id:sgtin:0614141.000000.33333",
            "urn:epc:id:sgtin:0614141.000000.44444",
            "urn:epc:id:sgtin:0614141.000000.66666",
            "urn:epc:id:sgtin:0614141.000000.77777",
            "urn:epc:id:sgtin:0614141.000000.88888",
            "urn:epc:id:sgtin:0614141.000000.99999",
            "urn:epc:id:sgtin:0614141.000000.12121"
          ],
          "action": "ADD",
          "bizStep": "commissioning",
          "disposition": "active",
          "readPoint": {
            "id": "urn:epc:id:sgln:0812345002.00.20202"
          },
          "bizTransactionList": [
            {
              "type": "po",
```

```
        "bizTransaction": "urn:epcglobal:cbv:bt:0614141000012:XYZ987"
      }
    ],
    "quantityList": [
      {
        "epcClass": "urn:epc:idpat:sgtin:0614141.000000.*",
        "quantity": 1
      }
    ]
  },
  {
    "type": "ObjectEvent",
    "eventTime": "2022-03-01T08:24:00-05:00",
    "eventTimeZoneOffset": "-05:00",
    "epcList": [
      "urn:epc:id:sscc:0812345002.0000000"
    ],
    "action": "ADD",
    "bizStep": "commissioning",
    "disposition": "active",
    "readPoint": {
      "id": "urn:epc:id:sgln:0812345002.00.20202"
    }
  },
  {
    "type": "AggregationEvent",
    "eventTime": "2022-03-01T08:29:00-05:00",
    "eventTimeZoneOffset": "-05:00",
    "parentID": "urn:epc:id:sscc:0812345002.0000000",
    "childEPCs": [
      "urn:epc:id:sgtin:0614141.000000.11111",
      "urn:epc:id:sgtin:0614141.000000.22222",
      "urn:epc:id:sgtin:0614141.000000.33333",
      "urn:epc:id:sgtin:0614141.000000.44444",
      "urn:epc:id:sgtin:0614141.000000.66666",
      "urn:epc:id:sgtin:0614141.000000.77777",
      "urn:epc:id:sgtin:0614141.000000.88888",
      "urn:epc:id:sgtin:0614141.000000.99999",
      "urn:epc:id:sgtin:0614141.000000.12121"
    ],
    "action": "ADD",
    "bizStep": "packing",
    "disposition": "in_progress",
    "readPoint": {
```

```
                "id": "urn:epc:id:sgln:0812345002.00.20202"
              },
              "childQuantityList": [
                {
                  "epcClass": "urn:epc:idpat:sgtin:0614141.000000.*",
                  "quantity": 1
                }
              ]
            },
            {
              "type": "ObjectEvent",
              "eventTime": "2022-03-01T08:35:00-05:00",
              "eventTimeZoneOffset": "-05:00",
              "epcList": [
                "urn:epc:id:sscc:0812345002.0000000"
              ],
              "action": "OBSERVE",
              "bizStep": "shipping",
              "disposition": "in_transit",
              "readPoint": {
                "id": "urn:epc:id:sgln:0812345002.00.0"
              },
              "bizTransactionList": [
                {
                  "type": "desadv",
                  "bizTransaction": "urn:epcglobal:cbv:bt:0812345002003:ABC1234"
                }
              ],
              "destinationList": [
                {
                  "type": "location",
                  "destination": "urn:epc:id:sgln:0614141.00001.0"
                }
              ]
            }
          ]
        }
      }
```

8.3.4 Brand-Provided Data (case with 1 RFID tag not read)

This example mirrors the brand-provided data example, except that the tag of one of the items is unread. This event represents the receiving of the case by the DC by scanning the SSCC labeled on the case and reading the tags of nine other items inside the case. Providing this event to the retailer, without any additional events illustrating an inspection of the case, would indicate that the DC has inferred the case is complete. Like with the other brand-provided data example, the brand could relay the factory data showing the factory confirmed the contents of the case and was able to read the tag with serial number 55555. This example shows both the factory data and brand DC data within a single document.

If necessary, the brand could hide portions of the data to avoid revealing sensitive business information[8]. For example, the brand may consider the identity of the factory sensitive and chooses to redact the GLN of the factory from the data relayed to the retailer. The EPCIS standard and implementation guideline offer key considerations for implementations wishing to provide access to a subset of information (see section on Authorization in the EPCIS Standard and section on Redaction of EPCIS Event Data in the Implementation Guideline).


```
{
    "@context": [
      "https://ref.gs1.org/standards/epcis/2.0.0/epcis-context.jsonld"
    ],
    "type": "EPCISDocument",
    "schemaVersion": "2.0",
    "creationDate": "2022-03-01T13:31:21.170Z",
    "epcisBody": {
      "eventList": [
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:23:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sgtin:0614141.000000.11111",
            "urn:epc:id:sgtin:0614141.000000.22222",
            "urn:epc:id:sgtin:0614141.000000.33333",
            "urn:epc:id:sgtin:0614141.000000.44444",
            "urn:epc:id:sgtin:0614141.000000.55555",
            "urn:epc:id:sgtin:0614141.000000.66666",
            "urn:epc:id:sgtin:0614141.000000.77777",
            "urn:epc:id:sgtin:0614141.000000.88888",
            "urn:epc:id:sgtin:0614141.000000.99999",
            "urn:epc:id:sgtin:0614141.000000.12121"
          ],
          "action": "ADD",
          "bizStep": "commissioning",
          "disposition": "active",
          "readPoint": {
            "id": "urn:epc:id:sgln:0812345002.00.20202"
          },
```


[8] See https://www.gs1.org/standards/epcis-and-cbv-implementation-guideline/current-standard section named "Redaction of EPCIS Event Data".

```
      "bizTransactionList": [
        {
          "type": "po",
          "bizTransaction": "urn:epcglobal:cbv:bt:0614141000012:XYZ987"
        }
      ]
    },
    {
      "type": "ObjectEvent",
      "eventTime": "2022-03-01T08:24:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "epcList": [
        "urn:epc:id:sscc:0812345002.0000000"
      ],
      "action": "ADD",
      "bizStep": "commissioning",
      "disposition": "active",
      "readPoint": {
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      }
    },
    {
      "type": "AggregationEvent",
      "eventTime": "2022-03-01T08:29:00-05:00",
      "eventTimeZoneOffset": "-05:00",
      "parentID": "urn:epc:id:sscc:0812345002.0000000",
      "childEPCs": [
        "urn:epc:id:sgtin:0614141.000000.11111",
        "urn:epc:id:sgtin:0614141.000000.22222",
        "urn:epc:id:sgtin:0614141.000000.33333",
        "urn:epc:id:sgtin:0614141.000000.44444",
        "urn:epc:id:sgtin:0614141.000000.55555",
        "urn:epc:id:sgtin:0614141.000000.66666",
        "urn:epc:id:sgtin:0614141.000000.77777",
        "urn:epc:id:sgtin:0614141.000000.88888",
        "urn:epc:id:sgtin:0614141.000000.99999",
        "urn:epc:id:sgtin:0614141.000000.12121"
      ],
      "action": "ADD",
      "bizStep": "packing",
      "disposition": "in_progress",
      "readPoint": {
        "id": "urn:epc:id:sgln:0812345002.00.20202"
      }
```

```
        },
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T08:35:00-05:00",
          "eventTimeZoneOffset": "-05:00",
          "epcList": [
            "urn:epc:id:sscc:0812345002.0000000"
          ],
          "action": "OBSERVE",
          "bizStep": "shipping",
          "disposition": "in_transit",
          "readPoint": {
            "id": "urn:epc:id:sgln:0812345002.00.0"
          },
          "bizTransactionList": [
            {
              "type": "desadv",
              "bizTransaction": "urn:epcglobal:cbv:bt:0812345002003:ABC1234"
            }
          ],
          "destinationList": [
            {
              "type": "location",
              "destination": "urn:epc:id:sgln:0614141.00001.0"
            }
          ]
        },
        {
          "type": "ObjectEvent",
          "eventTime": "2022-03-01T20:15:00-06:00",
          "eventTimeZoneOffset": "-06:00",
          "epcList": [
            "urn:epc:id:sscc:0812345002.0000000",
            "urn:epc:id:sgtin:0614141.000000.11111",
            "urn:epc:id:sgtin:0614141.000000.22222",
            "urn:epc:id:sgtin:0614141.000000.33333",
            "urn:epc:id:sgtin:0614141.000000.44444",
            "urn:epc:id:sgtin:0614141.000000.66666",
            "urn:epc:id:sgtin:0614141.000000.77777",
            "urn:epc:id:sgtin:0614141.000000.88888",
            "urn:epc:id:sgtin:0614141.000000.99999",
            "urn:epc:id:sgtin:0614141.000000.12121"
          ],
          "action": "OBSERVE",
```

```
            "bizStep": "receiving",
            "disposition": "in_progress",
            "readPoint": {
              "id": "urn:epc:id:sgln:0614141.00001.32323"
            },
            "bizLocation": {
              "id": "urn:epc:id:sgln:0614141.00001.0"
            }
          }
        ]
      }
    }
```

8.3.5 Manual Audit Data

A manual audit will either confirm or dispute the assertion made by the supplying trade partner that certain items are in a given case/carton. Manual audit results may be systematized and structured in the same way that suppliers provide case/carton content information. The GLN for the manual audit location is supplied. The master data associated with that GLN shared with trade partners indicates a location used for manual audits.[9] Such data can be systemically shared with trading partners to potentially automate claims matters as well as update case/carton content for inventory visibility purposes.

[9] For an overview of GLN see *https://www.gs1.org/standards/gln-data-model-solution-standard/current-standard* and for details on the GLN master data model, see the "GLN data model attributes" section.

9 Appendix

9.1 GLN

The Global Location Number (GLN) is a globally unique GS1 Identification Key used to identify parties and locations. The GLN allows users to answer the questions "who" and "where" within their own organization and throughout the entire, global supply chain.

The GLN is a 13-digit number that includes three components:

- **GS1 Company Prefix:** A globally unique number licensed to a company by a GS1 Member Organization to serve as the foundation for generating GS1 Identification Keys (e.g., GLN, GTIN). GS1 Company Prefixes are assigned in varying lengths depending on the company's needs.
- **Location Reference:** A number, containing no logic, assigned by the user to identify the party or location. The Location Reference varies in length based on GS1 Company Prefix length.
- **Check Digit:** The final digit calculated from the preceding digits of the GLN. This digit is used to check that the data has been correctly composed. GS1 US provides a *check digit calculator* to automatically calculate check digits for you.

GS1 Company Prefix licenses may be obtained from any GS1 member organization. Holders of a licensed GS1 Company Prefix are able to generate GLNs. If an organization wishes to obtain a GLN and does not have a GS1 Company Prefix license, they may obtain a GLN by contacting any GS1 member organization.

- GS1 US also provides this link to directly license a GLN: *https://www.gs1us.org/global-location-number/get-a-global-location-number*

9.2 SSCC

The Serial Shipping Container Code (SSCC) is the GS1 Identification Key used to identify a logistic unit. This is what is often encoded in the GS1-128 barcode placed on the case/carton and provides unique identification of a logistics unit. This identification includes the GS1 Company Prefix, which is a globally unique company identifier licensed by GS1 member organizations.[10]

This unique identifier is comprised of an Extension Digit, a GS1 Company Prefix, a Serial Reference, and a Check Digit.

---

[10] For more information, see "An Introduction to the Serial Shipping Container Code (SSCC)": *https://www.gs1us.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=177*

- **The extension digit** is used to increase the capacity of the serial reference within the SSCC. It is assigned by the company that constructs the SSCC. The extension digit ranges from 0-9.

- **The GS1 Company Prefix** is allocated by GS1 Member Organizations to the company that allocates the SSCC – here the physical builder or the brand owner of the logistic unit. It makes the SSCC unique worldwide but does not identify the origin of the unit.
- **The structure and content of the serial reference** is at the discretion of owner of the GS1 Company Prefix to uniquely identify each logistic unit.
- **The check digit** is for its verification, which must be carried out in the application software, ensures that the number is correctly composed.

9.3 Corrective Actions

The following list various possible corrective actions for different failure modes. These serve as examples of one or many possible actions. Not all actions would need to be taken for a given scenario.

CA 1 - Extra Untagged Item Present

1. Send the extra item back to the brand[11]
2. Dispose of the extra item
3. Notify the brand about the extra item and act as per their suggestion

CA 2 - Tag Present Without Item

1. Destroy/discard the tag to avoid additional tags in the RF environment, replace it with a correctly tagged item (if available), and update the system with the new EPC number
2. Notify the brand and act as per their suggestion
3. Capture the concealed shortage and adjust WMS and ASN values accordingly

CA 3 - Item Over-Picked

1. Remove additional item and return to brand
2. Remove additional item and discard of it
3. Retain additional item as inventory and update inventory management system to account for it
4. Notify the brand about the extra item and act as per their suggestion

CA 4 - Multiple Tags on One Item

1. Locate the extra tag, remove it from the item, and destroy the tag
2. Remove the item with extra tag and send back to the brand, replace it with a correctly tagged item, and update the system with the new EPC number
3. Send the item on through, noting the discrepancy

CA 5 – Environmental Tag Read

1. Make sure there are no stray products, cartons, or tags in the vicinity of the reader. If present, they must be kept away from the RF environment.
2. Make sure tags are not being read from surrounding case/cartons
3. Refine and retune RFID hardware and/or shielding configurations to minimize subsequent environmental tag reads

[11] If the item is one that the brand would normally sell, they will generally keep it. This concealed overage is reported as an accuracy issue but is rarely paid for by the retailer. Retailers may pay for it if invoiced but invoicing is not practical. Some retailers will pay for the item even if in excess of the invoice. This creates "cash on account" and also some financial accounting resolution for what to do with payment in excess of the invoice.

CA 7 - Item Under-Picked

1. Adjust order for under-picked items and send the carton on noting the discrepancy (incurring a claim to the brand or supplier)
2. Inform the brand and request the remaining items in additional orders

CA 8 - Non-Performing Tag

1. Locate the item with non-performing tag, destroy the tag, replace the tag with a functional tag, and update the system with the new EPC number
2. Replace the item with a new item having a functional tag and update the system with the new EPC number
3. Do not replace the tag, instead capture this information and share it with trade partners per section X.

CA 9 - Untagged Item

1. Locate the untagged item and attach a tag to it, update the system with the new EPC number
2. Return the item to the brand and replace with a tagged item, update the system with the new EPC number
3. Do not replace the tag, instead capture this information and share it with trade partners per section X.

CA 10 - Unencoded/Mis-Encoded

1. Locate the item, replace the tag with a valid tag, update the system with the new EPC number
2. Remove the item and replace it with a new item having a valid tag, update the system with the new EPC number
3. Send the item through on noting the discrepancy
4. Locate the item, re-encode the tag if not permalocked
5. Do not replace or re-encode the tag, instead capture the null tag information and share it with trade partners per section X.

CA 11 - Duplicate Serialization

1. Locate the item, replace the tag with a valid tag, update the system with the new EPC number, and destroy the unwanted tag
2. Locate the item, replace the item, update the system with the new EPC number
3. Locate the item, re-encode the tag if not permalocked

CA 12 - Unknown Item in Case

1. Return the unknown item to the brand
2. Discard the unknown item
3. Notify the brand about the unknown item and act as per their suggestion

CA 13 - Unencoded/Mis-Encoded

1. Locate the item and return it back to the brand
2. Locate the item and discard it
3. Locate the item, replace the tag with a valid tag and place the item in the inventory and update inventory management system to account for it

CA 14 - Incorrect Tag

1. Locate the item with unknown tag and replace the tag with a valid tag, update the system with the new EPC number
2. Locate the item with unknown tag and replace the item with an item having a valid tag, update the system with the new EPC number
3. Send the item on through without correcting the tag, noting the discrepancy

9.4 Third-Party Logistics Providers

Third-Party Logistics (3PL) providers may provide inspection processes on behalf of a trade partner. In these cases, the 3PL may leverage the same processes described above on behalf of their client. If doing so, the GLN of the 3PL must follow the same guidance as above (it must be a single, unique, consistent identifier that is packaged with the data collected by the station). That fact that the GLN is identifying a 3PL will be shared with any trading partner receiving such data.

9.5 Mask Designer ID Audits

The Mask Designer ID (MDID) serves to identify the RFID inlay chip manufacturer and Tag Model Number. Such data is encoded in the TID memory block, which is a read-only portion of the RFID tag memory not normally accessed in the context described in this document. Trading partners may opt to leverage the infrastructure described in this document to occasionally capture this information. Such capture may allow trading partners to detect the chip manufacturer and chip type, allowing some measure of visibility into source tagging compliance.[12]

[12] For more information, see *https://www.gs1.org/epcglobal/standards/mdid*

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IAPMO

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*If applicable

GS1 US Corporate Headquarters

Princeton South Corporate Center, 300 Charles Ewing Boulevard
Ewing, NJ 08628 USA
T +1 937.435.3870 | **E** info@gs1us.org

www.gs1us.org

Connect With Us