Implementation Guide for the use of GS1 EPCglobal Standards in the Consumer Electronics Supply Chain

Document Summary

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Document Description	Implementation Guide document that provides an introduction to the Consumer Electronics Supply Chain and the GS1 organisation as well as guidance to all Consumer Electronics supply chain stakeholders on implementing GS1 EPCglobal Standards.

Contributors

GS1, in collaboration with stakeholders from the Consumer Electronics (CE) industry and GS1 Member Organisations (MOs), discuss and define Consumer Electronic Industry supply chain needs to help drive efficiencies in key operations, improve visibility of goods as they travel through the supply chain and ensure benefits for all CE supply chain partners leading to improved customer satisfaction. This document was compiled in collaboration with key members of the GS1 EPCglobal Consumer Electronics Industry Action Group (CE IAG). The CE IAG explored the benefits of EPC and RFID and the visibility data it supports to enhance business processes and customer services.

First name	Last Name	Organisation
Kerry	Angelo	GS1 Global Office
Greg	Edds	HP
Mark	Frey	GS1 Global Office
Martin	Hampel	GS1 Germany
Patrick	Javick	GS1 US
Hyunsoo	Kim	Kyonggi University, Rep. of Korea
Audrey	Kremer	GS1 Global Office
Nori	Mama	GS1 Japan
Giselle	Ow-Yang	GS1 Global Office

Ian	Robertson	GS1 Global Office
Wendy	Sadler-Moyes	GS1 Australia
Paula	Valério	Flextronics, HP Brazil
Akihiko	Yamagata	Sony Corporation
Tatsuya	Yoshimura	Sony Corporation

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1. Executive Summary

For more than 30 years, GS1 has been dedicated to the design and implementation of global standards for use in the supply chain. GS1 standards provide a framework that allows products, services and information to move efficiently and securely for the benefit of businesses and the improvement of people's lives. GS1 standards ensure effective exchanges between companies and act as basic guidelines that facilitate interoperability and provide structure to many industries. This Implementation Guideline on the use of GS1 EPCglobal standards in the Consumer Electronics supply chain provides an introduction to the CE supply chain, the GS1 organisation and GS1 standards specifically concerning EPCglobal. GS1 EPCglobal supports the global adoption of the Electronic Product Code (EPC) as a global standard to enable accurate information and visibility about products in the supply chain. Key implementation procedures indicating where and how EPCglobal standards could be used and the benefits achieved are outlined.

2. Introduction

GS1 keys and standards, together with Radio Frequency Identification (RFID) the selected GS1 data carriers and traceability guidelines, will facilitate lifecycle management of consumer electronics and provide traceability through each step of the global multi-partner supply chain. The industry works on a national, international and global level. It consists of both global and local manufacturers, together with associated services such as transport and logistics. Retailers for this industry are local and international.

2.1. Objectives

To provide guidance to global consumer electronics supply chain partners on implementing EPCglobal standards. Our aim is to provide industry representatives with practical information on how RFID and EPCglobal standards can help drive changes in the CE industry supply chain that lead to benefits for all participants. This document provides the reader with an overview of the CE industry, key processes and the EPCglobal standards that could be used to drive efficiencies. This is not a technical guideline. References to relevant technical support documentation have been included in chapter 11.

2.2. Document Scope

Provide guidance on the use of existing EPCglobal standards for EPC enabled RFID in prioritized business use cases. The recommended implementations specified in this document apply to barcoded and RFID tagged product at pallet, case and item level. Item level tagging on both small CE products (e.g. laptop computer, digital camera, mobile phone etc.) and large products (e.g. Plasma television screen, refrigerator, etc.) are explored. The high class product category only is addressed including:

- Products requiring item level traceability for product safety, recycling, maintenance/repair, etc.
- Products needing item level tag either embedded into product or attached directly on product

This document does not provide a detailed outline of use case process steps. The use cases presented in chapter 7 are based on more detailed business operations description worksheets developed by the CE IAG. Business Operations Worksheets are available upon request by contacting Audrey.Kremer@gs1.org

2.3. Intended Audience

This document is intended for all stakeholders in the global CE supply chain that want to implement EPCglobal standards and members of GS1 CE activities. In addition, it can be used by GS1 MOs to

support implementation efforts of their local members. It is anticipated that this document may be tailored (localised) by some MOs, (i.e. translated into local languages). Knowledge of GS1 terminology and standards is assumed.

3. Industry Background

Consumer electronics include electronic equipment intended for everyday use. Some products classed as consumer electronics include personal computers, televisions, DVD players, refrigerators, hairdryers as well as products often used in entertainment, communications and office productivity. Consumer electronics are manufactured throughout the world, although there is a particularly high concentration of manufacturing activity in Japan, the United States, South Korea and China.

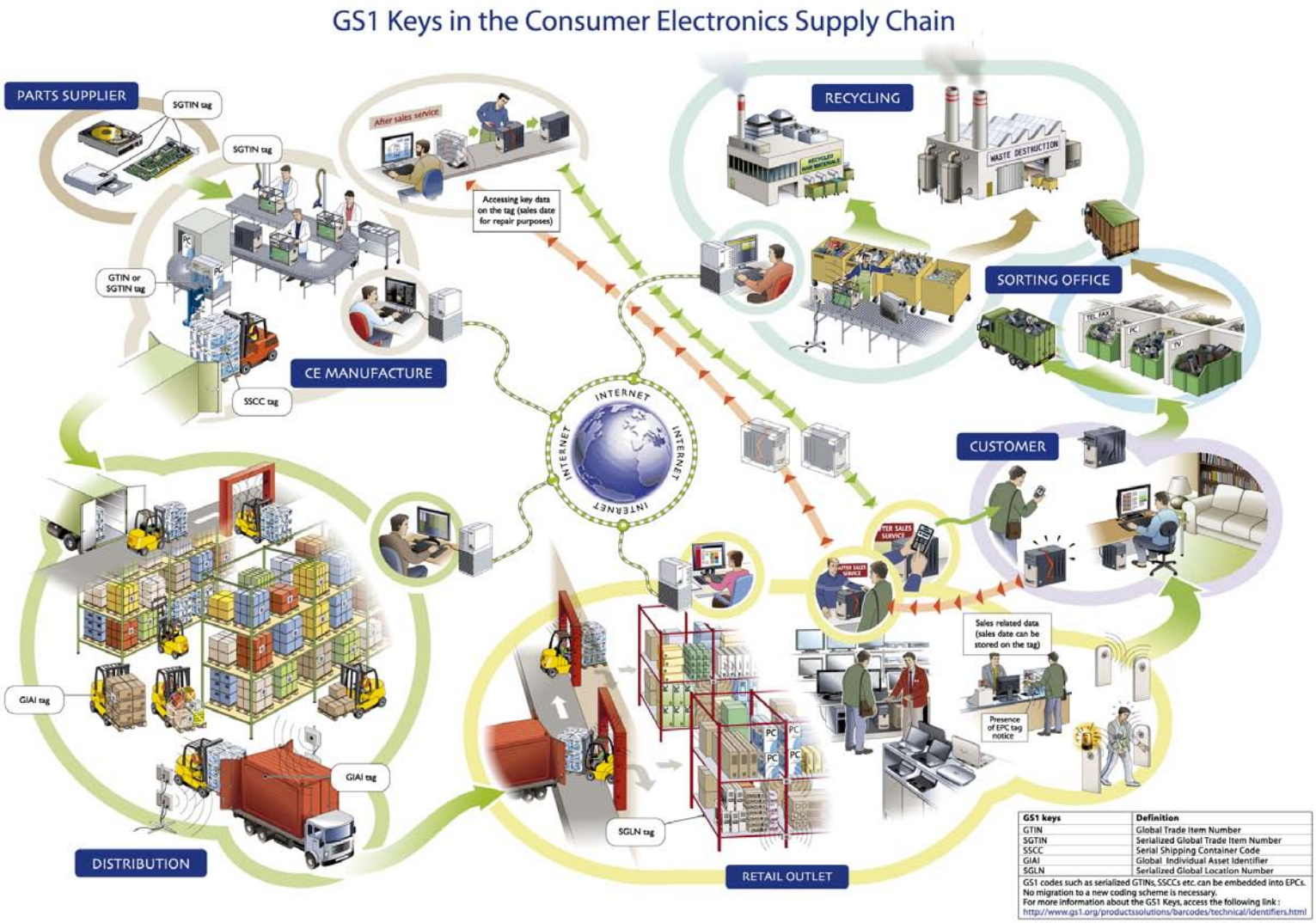
The latest product trends reflect the development of lighter and more efficient CE goods. This has a positive effect on Transportation, Reverse Logistics and End of Life (EOL) processes.

Consumer Electronics Sector Characteristics

- Lean and global supply chain management is a crucial success factor in an increasingly competitive business environment characterised by high cost pressure, global sourcing and long lead and transportation times
- As transported goods move through multiple parties (e.g. manufacturers, logistics service providers, retailers) until arriving at the final customer at the Point of Sale (POS), it is beneficial for all players involved to use the same identification and communication standards along the entire supply chain
- Consumer electronic products typically have a short life cycle, therefore providing rich product data in high quality and in a standardised way is crucial for successful sales processes.
- Technical and sales related information is required for consumer electronics products at the POS.
- Consumer electronics products tend to be of high value and therefore are likely to be a target for counterfeiting.

3.1. CE Total Product Lifecycle Management

The EPCglobal Consumer Electronics Industry Action Group (CE IAG) explored the benefits of using RFID enabled business processes through the utilisation of EPC to improve the consumer electronics global supply chain in all aspects. RFID tags on products will enable lifecycle management of consumer electronics and provide traceability from the procurement of parts and components to manufacturing, distribution, sales, servicing and maintenance and recycling. This will ensure that consumer electronics products are dependable, safe and easy on the environment.



3.2. Supply Chain Participants

Supply chain partners in the following roles participated in all or some of the following logistics operations:

3.2.1. Supplier/Manufacturer

Receiving and inventory management including: manufacturing processes, providing basic and product specific master data to retailers, ordering, delivering and invoicing processes, order picking, shipping and transportation.

3.2.2. Logistics Providers

Warehousing: Handling and storage of products, transform, consolidate and deconsolidate units/lots, receiving of product, inventory management and order picking.

Shipping: Transport and delivery of raw materials, packaging and/or finished products and Tracking/Tracing.

Distribution: Receiving and inventory management of final products, ordering from several manufacturers and delivery to several customers.

3.2.3. Retailer

Receiving and inventory management of final products in a central distribution centre and/or at the POS. Ordering, delivering and invoice processes – ideally in a single standardised way with various partners. There is a need to respect local requirements (e.g. supplier relationships, category management, advertising and prices) while dealing in a standardised way with business partners. Retailers aim to decrease logistics costs and process time by enhanced automated processes, as well as increasing product availability and thereby generating an increase in turnover and profit. Retailers also have the opportunity to managed returned products more efficiently when products are identified at item level. This enables them to access warranty information in relation to the sale of the returned product on a centralised database.

3.2.4. Consumer

The consumer buys the product at their preferred retail outlet. The consumer requests high product availability, no out-of-stocks, a high level of product information for at POS, a high service level and a long warranty period.

3.2.5. Repair and Maintenance Service Provider

Warranty documents and receipts are needed for visibility of the repair history, to detect counterfeit products or illegally replaced components and to have access to information about the repaired or to be repaired product. An RFID tag could substitute product warranty documentation so that Repair and Maintenance service providers can access accurate warranty information in a more efficient “paper-free process”.

3.2.6. Recycler/EOL Operator

Collecting and inventory management for End of Life (EOL) products where the recycler requests a high level of product disassembling information and special handling information for hazardous materials.

3.3. Industry Priorities

With the globalization of the CE business model, increasing visibility and optimizing processes become central to an organisation's success. CE companies of all sizes are now forming partnerships and alliances in order to gain greater access to customers on domestic, cross-border and global markets. A standard approach to the technology used to enable the secure sharing of real-time information between trading partners is necessary. This will allow businesses to monitor the location and state of individual items as they pass through the supply chain thereby increasing visibility, safely, security, efficiency and traceability.

3.3.1. Security

Consumer Electronics products may be repaired and/or maintained by manufacturers or service providers during usage, therefore product information needs to be accessible not only by manufacturers, but by other players such as retailers, service providers and recycle companies. Security specifications for Hardware and Software standards are required. In terms of GS1 EPCglobal standards, there is a clear need to stop unauthorized access to data on a tag as well as data sharing authorization requirements. It is of utmost importance that information can be shared securely across multiple parties in the CE supply chain. In the case of Total Product Lifecycle (TPL) management of CE products, secure access to some product related data will be provided to certain supply chain partners. GS1 standards such as EPCIS and GDSN will help enable this.

3.3.2. Low Cost Manufacturing Resulting in Extended Supply Chains and the Need for Improved Visibility

GS1 standards can help drive efficiency even in the geographically dispersed CE supply chain, such as in transporting, storing, importing, dispatching and delivery to point of sale.

Major markets for CE products include Europe and North and South America. The migration of manufacturing operations to low cost countries, and in the case of the CE industry the migration to Asia, has created a vastly extended supply chain structure. This has extended supply chains in terms of geography, time and cost. Under such conditions, visibility of precisely what is happening along the chain becomes even more important. This global expansion of supply chains increases the number of players within the overall chain which highlights the importance of having the right information flow between all supply chain partners. Long lead times for the transportation of final products increases transportation costs substantially. Such costs can be reduced by increased information exchange to smoothen the entire procurement process along the global CE supply chain. GS1 standards cover multiple industries, are global, accommodate the Transport and Logistics sector and can help drive efficiencies in the geographically dispersed CE supply chain.

3.3.3. Granular Visibility

Currently, manufacturers have little visibility of products after shipment and their location in the supply chain. By attaching RFID tags containing EPCs on products, both the manufacturer and the retailer have better visibility of the product in the supply chain, making it easier to locate the product before and after sale and providing better customer support for the product.

Traditional Track and Trace systems using eCommerce transaction standards (EDI or XML) as an acknowledgement of the start and end of a business process does not provide detailed information on where the item was in between two points in the supply chain. The combination of GS1 standards and RFID technology can enable the viable automatic collection of this data beyond traditional event data using eCommerce transaction standards, thus providing much more granular data. The automatic collection also means more accurate data and avoiding the need to stop the flow of goods in order to identify them.

GS1 standards will enable CE companies to acquire much more information about events in their supply chain. The combination of detailed and more frequent collection of event data can provide companies with a revealing view of how their supply chain is operating. With mutual agreement between supply chain partners, CE companies can see the exact flow of inbound material, arrival of goods, when finished goods were outbound staged and when they were actually shipped.

GS1 standards can significantly improve a company's visibility of serialized instances by knowing: What something is, Where it was, When it was there, Why it was there and What condition it was in. GS1 standards can help companies: Identify items, capture information, exchange information and enquire about that information. This will help companies minimize inventories and gain a higher level of confidence in Just In Time (JIT) deliveries.

3.3.4. Cost Reduction

Precise information on vendor performance based upon accurate visibility of events, enables performance based relationships and cost profiles. Tying vendor reward to actual performance ensures a better vendor value proposition (get what you inspect rather than what you expect). Earlier notification of things going wrong enables earlier pro-active corrective action which tends to cost less.

If all partners in the supply chain can describe and identify products/things the same way, then overall costs are reduced as solutions, systems and procedures need be developed only once before being applied to many trading partners. This applies to item identification, item descriptions, process descriptions, data exchange, messages and data formats.

3.3.5. Process Accuracy

Having products in the right location in a warehouse or distribution centre is useful for component based manufacturing as one cannot rely on the physical form of a component only to accurately identify it.

The accurate identification of CE products and items can enhance process accuracy by ensuring that items are correctly routed for further processing. Barcodes provide a means for achieving this and Databar provides the means to carry much more data than traditional linear barcodes. RFID technology based on GS1 standards enables the automation of this process.

3.3.6. Time Saving Functionality - On Board Data

Accessing data held in extended user memory, instead of retrieving data held in a central system, can help save time in a process. The GS1 EPCglobal Gen2 Specification explains how tag memory is separated into four distinct banks described as: "Reserved", "EPC", "TID" and "User". The user memory bank is intended to contain user-specific data. For informational purposes, CE IAG users intend to store SSCC numbers as well as store information, product warranty and maintenance information. in user memory. The large user memory is specifically designed to address situations where network access is not always available.

3.3.7. Data Accuracy

The synchronization of information in global supply chains to reduce data errors, inconsistencies and duplication is highly beneficial for supply chain partners as it enables real time product information updates. As a result, trading partners have the same information in their systems and all participants can share important business information in a standardised way. This means the required information for manufacturing, planning, inventory, sales, finance and operation processes can be made accessible more effectively, This leads to improved accuracy of orders, fewer forms to fill out, fewer duplicated systems and processes and ultimately leads to a decrease in unnecessary costs along the entire global supply chain.

3.3.8. Public Policy

The responsible use of EPC RFID is of utmost importance for members of the GS1 EPCglobal CE IAG. Participants of this group adhere to *The Guidelines on EPC Usage for Consumer Products*. GS1 EPCglobal and its members are committed to the responsible deployment and use of EPC as they capture the benefits of the technology. The guidelines provide a practical and useful framework to help members achieve that objective. Go to www.epcglobalinc.org/public/ppsc_guide/ for more information.

3.3.9. The Environment

The CE market is characterised by dramatic changes in technology and retailing. Questions of environmental sustainability, energy efficiency and recycling are gaining importance. The CE IAG addressed the use of EPC/RFID to drive efficiencies in CE End of Life processes. The use of standards can also help the CE industry reduce the amount of electronic waste, since only defective components rather than whole products are discarded. A special indicator incorporated into the EPC memory bank of an EPC RFID tag can help CE End of Life operators appropriately dispose of hazardous materials.

3.3.10. Anti-Counterfeiting

EPC enabled RFID can help drive counterfeit products out of the supply chain. Examples of issues for the CE industry include when a fraud sells counterfeit product over the internet or on the black market. A counterfeit label is attached to the counterfeit product deceiving the customer into the belief that they are buying an authentic product. This results in a loss for the manufacturer in terms of sales. Brand value and reputation is also damaged. Another example of Anti-Counterfeiting in the CE industry is when a fraud applies to a CE manufacturer for the repair of a counterfeit CE product or a CE product he/she has illegally modified (i.e. a counterfeit label is attached to a counterfeit product or an illegally modified product deceiving the repair centre into believing this is an authentic tag and product). The manufacturer is at a loss in terms of labour costs – repairing counterfeit products or products that do not satisfy terms and conditions for the manufacturer's guaranty.

3.3.11. Product Recall

When problems occur with CE products after many years of use, responding quickly requires much time and energy. GS1 standards will make it possible to handle such problems in a timely manner thanks to product serialisation and effective track and trace systems. Businesses, end users and regulators in various markets around the world have an interest in establishing a common method to recall products at various points of the supply chain. The need exists for a standard set of business processes and the supporting data that enables trading partners in a supply chain to quickly and efficiently initiate a recall and track its progress through to its conclusion (i.e. the identified product is no longer available in the supply chain).

4. The Technology

The use of information technologies has revolutionised the way the CE industry and their supply chain partners do business. Innovations in logistics, web-based ordering, Electronic Data Interchange (EDI), automated storage and retrieval systems, RFID and many others, create a basis for knowledge sharing within and among the organisations involved in a given supply chain. This document specifically addresses the use of EPC/RFID and EPCglobal standards.

4.1.1. EPC and RFID

RFID is a data carrier that is used to encode or carry unique product identification. It supports automated reading of that unique identifier and the automated capture of the physical event around this identifier (i.e. the: when, where and why of the business process or step associated with the event). Two elements

are needed: a tag and a reader. The Electronic Product Code (EPC) is a unique number that is used to identify a specific item in the supply chain. The EPC is stored on an RFID tag, which combines a silicon chip and an antenna. Once the EPC is retrieved from the tag, it can be associated with dynamic data held in a secured database such as where an item originated or the date of its production.

The following components are designed to work together to give maximum visibility within a supply chain:

- The EPC (Electronic Product Code)
- Tags
- Readers
- Software that helps all of the pieces communicate in a “common” language.

This system greatly enhances product visibility along the supply chain helping businesses minimise extra costs from their internal operations, by addressing issues such as internal theft, out-of-stocks, counterfeiting, etc. This in turn drives down the cost of doing business, which helps businesses succeed by applying downward pressure on consumer prices.

To find out more about the items listed below, go to the RFID and EPC Essentials presentation at the following link: www.epcglobalinc.org/what/cookbook/chapter1/002-RFID_EPC_Essentials_v1.pdf

- What is EPC
- Introduction to tags and readers
- Introduction to EPCglobal network
- Bit formats of GTIN, GLN and SSCC
- Bit formats of other keys

4.1.2. Internet

Information technology development, and in particular use of the internet, has revolutionised the flow of information between trading partners and governments. Today the internet allows searching, tracking and tracing of goods as they move through the supply chain.

5. Overview of GS1 Standards

The GS1 System is an integrated system of global standards that provides for accurate identification and communication of information regarding products, assets, services and locations. It is the most implemented system of supply chain standards in the world.

The GS1 System is the foundation of a wide range of efficiency-building supply chain applications and solutions. Based on GS1 Identification Keys, a common recurring set of identification keys, the GS1 System is composed of our main product areas:

EPCglobal is a global standards system which combines RFID technology, existing communications network infrastructure and the Electronic Product Code to enable immediate and automatic identification and tracking of an item through the entire global supply chain, resulting in improved efficiency and visibility.

eCom global standards for electronic business messaging allow rapid, efficient and accurate automatic electronic transmission of agreed business data between trading partners. eCom is based on two components: GS1 EANCOM and GS1 XML

The **Global Data Synchronisation Network™** (GDSN™) is an automated, standards-based, global environment that enables secure and continuous data synchronisation, allowing all partners to have consistent item data in their systems at the same time. Global Product Classification (GPC) is a key component of GDSN, enabling effective category management.

GS1 BarCode global data and application standards for use the globally recognised GS1 Identification Keys to automatically identify things such as trade items, locations, logistic units and assets.

5.1. Benefits of Using GS1 Standards in the CE Supply Chain

- Decreased costs of production and procurement.
- Improved sales information and optimised assortments.
- Increased product availability and less out-of-stocks.
- Intensified collaboration helps to better meet customer needs.
- Lower human errors.
- Lower inventories – less capital lockup.
- Reduced number of supply chain partner disputes.
- Time and cost savings in product preparation, shipping and receiving – increased speed to market.
- Improved and more effective after sales services.

- Advanced traceability secures efficient management of product recalls and makes counterfeiting more difficult.
- Advanced traceability of End of Life products reduces environmental burdens by proper recycling.

6. The Data

EPC/RFID enables you to acquire much more information about events in your supply chain. This detailed and frequent collection of event data provides a revealing view of how your supply chain is operating. GS1 EPCglobal standards enable sharing of data, however collected, in ways that drive common interpretation of that data. It is this unique ability to have in-depth visibility of what is really happening in a company's operations that creates the opportunity to establish trends, identify problems and subsequently resolve them resulting in improved key performance indicators. This impacts a company's profit and loss and balance sheet as well as improving customer service.

The **EPC Network** is an architecture of open standard interfaces that are designed to support greater visibility of the location and movement of objects within supply chains, with granularity down to the unique EPC identifier of each object (i.e. serial-level visibility). The EPC Network architecture allows for very distributed data management and control. Each organization that handles an object can automatically capture observations of objects that they handle and link this to information systems that record these events, together with the business context in which they happened.

The **EPC Information** Services standard provides a standard interface to allow companies to exchange such granular information through a common query protocol and reporting format. The EPCglobal Object Naming Service (ONS), the focus of this document, is designed to provide a lookup mechanism so that anyone can find the address of services (such as EPCIS repositories) that are designated by the organization that issued the EPC identifier of a particular object. The EPCglobal ONS is designed to contain only entries for non-serialized identifiers.

Discovery Services will provide a complementary lookup mechanism to enable authorized authenticated clients to discover multiple sources of information contributed by several different organizations that have had an involvement with a specific EPC. The three key differences between ONS and Discovery Services are summarized in the table below.

Object Naming Service (ONS)	Discovery Services (DS)
Provides pointers to one or more services designated by the creator of an EPC class	Provides pointers to one or more services designated by multiple organizations that have handled a specific serialized EPC or who claim to hold some information about it
Provides records only at non-serial-level	Provides records at serial-level
Anonymous query supported - no authentication required by query clients	Likely to require authentication of clients and resource owners that interact with Discovery Services

In summary: ONS can help anyone find the start of a supply chain; whereas Discovery Services will be able to help authorized users find multiple sources of information across supply chain or product lifecycle. Many visibility applications will use the existing EPCIS standard (for capture, query and exchange of serial-level information) together with Discovery Services (for finding multiple sources of serial-level

information). ONS may be used for bootstrapping to the initial instance of Discovery Service (or EPCIS) for an EPC class of issued identifiers.

6.1. What is Visibility Data?

In the context of supply chains/networks and product lifecycles, visibility is a concept that encompasses four key questions:

1. Where is my stuff? (Traceability)
2. Where has my stuff been? (Traceability)
3. Is my stuff real? (Authenticity)
4. Who has handled my stuff? (Chain of custody)

Inventory Visibility • Product visibility • Asset visibility • Repair, maintenance and recycling	Visibility enables traceability of products
Brand Protection • Anti-counterfeiting • Diversion, gray market • Channel management	Visibility enables traceability and authentication of products
Chain of Custody • Track and trace • Electronic pedigree	Visibility supplies the custody information for creating an authenticated chain of custody

6.2. Class Level Data and Serialized Level Data

Class level data is data about a set of objects belonging to the same class – a GTIN level (i.e. product level data).

Serialized data is data about a specific instance of something belonging to a class (i.e. instance level data).

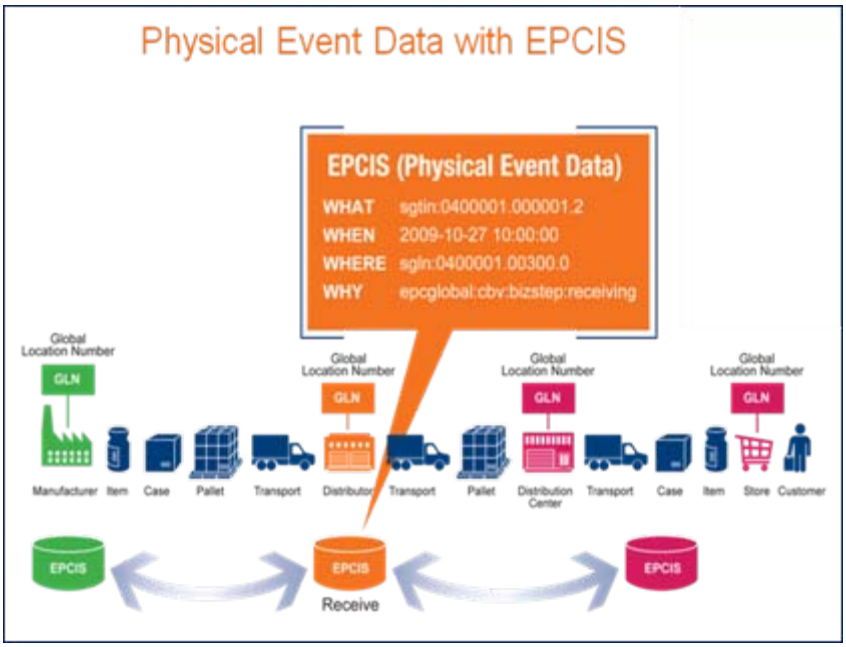
Therefore, if class level data is “50ml plastic bottle of Coke” then serialized data is “this **specific** 50ml plastic bottles of Coke”.

6.3. EPCIS (Electronic Product Code Information Services)

EPCIS is an industry standard providing the capability for unprecedented visibility into the movement, location and disposition of assets, goods and services throughout the world. EPCIS is used to track the progress of objects as they move through the supply chain. The data shared at each read point in the supply chain provides the What, When, Where and Why of each EPC event. The EPCIS Standard provides the foundation necessary for the capture, communication and discovery of EPC event data. It enables standard event capture and query interfaces for obtaining and sharing data about unique objects in the supply chain within and across organisations.

6.4. Overview of EPCIS and Core Business Vocabulary Standards

Physical events are actual observations made in the physical world of products or other assets. Each observation captures what was observed, when it was observed, where it was observed and why it was observed (that is, what was the business context in which the observation took place). Often physical event data is generated as the result of automatic identification, such as scanning a bar code or reading an RFID tag. The GS1 standards that support physical event data are EPC Information Services or EPCIS and the Core Business Vocabulary (CBV).



6.5. EPCIS

EPCIS is an EPCglobal standard for visibility information at a business level. It provides a data model for events in the life of uniquely identified objects that describe the what, where, when and why of an event. It includes two standard interfaces for capture and query of events. EPCIS is industry and application agnostic, providing a cross-industry framework for physical event data sharing. It allows for cross-industry and industry-specific vocabularies and extensions. The standard is user-extensible to allow for maximum flexibility within and beyond the four walls of an organization. EPCIS provides for the exchange of a new kind of data (physical events). It is a supplement to, not a replacement for, existing enterprise information systems and other B2B messaging such as EDI.

6.6. Core Business Vocabulary

The EPCIS standard (EPCIS1.0.1) specifies the data elements in an EPCIS event. The following lists these data elements, and indicates where the Core Business Vocabulary provides identifiers that may be used as values for those data elements.

- The “what” dimension: For most event types contains one or more unique identifiers for physical objects.
- The “when” dimension: The moment in time at which an EPCIS event occurred. Event time is fully specified in the EPCIS standard.
- The “where” dimension: Consists of two identifiers that describe different aspects of where an event occurred:
- Read Point: The location where the EPCIS event took place. In the case of an EPCIS event arising from reading an RFID tag, the Read Point is often the location where the RFID reader read the tag. Identifiers for read points in the Core Business Vocabulary are specified in Section 8.3 of that standard

Example: A reader is placed at dock door #3 at the London Distribution Centre (DC). Product passed through the dock door. Read point = <The identifier that stands for London DC Dock Door #3>

Business Location: The location where the subject of the event is assumed to be following an EPCIS event, until a new event takes place that indicates otherwise. Identifiers for business locations in the Core Business Vocabulary are specified in Section 8.3.

Example: A product is read through the sales floor transition door at store #123. The product is now sitting on the sales floor. Business location = <The identifier that stands for store #123 Sales Floor>

The “why” dimension The “why” dimension consists of two identifiers and a list of business transaction identifiers, which collectively provide the business context or “why” the event occurred:

Business Step: Denotes a specific activity within a business process. The business step field of an event specifies what business process step was taking place that caused the event to be captured. Identifiers for business steps in the Core Business Vocabulary are specified in Section 7.1 of that standard.

Example: an EPCIS event is generated as a product departs the location identified by the Read Point. Business Step = <The identifier that denotes “shipping”>

Disposition: Denotes the business state of an object. The disposition field of an event specifies the business condition of the subject of the event (the things specified in the "what" dimension), subsequent to the event. The disposition is assumed to hold true until another event indicates a change of disposition. Identifiers for dispositions in the Core Business Vocabulary are specified in Section 7.2 of that standard

Example: an EPCIS event is generated and afterward the products can be sold as-is and customers can access product for purchase. Disposition = <The identifier that denotes "sellable and accessible">

Business Transaction References An EPCIS event may refer to one or more business transaction documents. Each such reference consists of two identifiers:

Business Transaction Type: Denotes a particular kind of business transaction. Example: the identifier that denotes "purchase order". Identifiers for business transaction types in the Core Business Vocabulary are specified in Section 7.3 of that standard.

Business Transaction Identifier: Denotes a specific business transaction document of the type indicated by the Business Transaction Type. Identifiers for business transactions in the Core Business Vocabulary are specified in Section 8.4 of that standard.

Example: <The identifier that denotes Example Corp purchase order #123456>

7. Implementation Procedures

In this chapter, priority use cases for the CE industry are presented in use case tables. For each use case addressed, we indicate:

1) Which EPCglobal standards could be used to help drive process efficiencies.
2) How those standards could be used.
3) The benefits of their use.

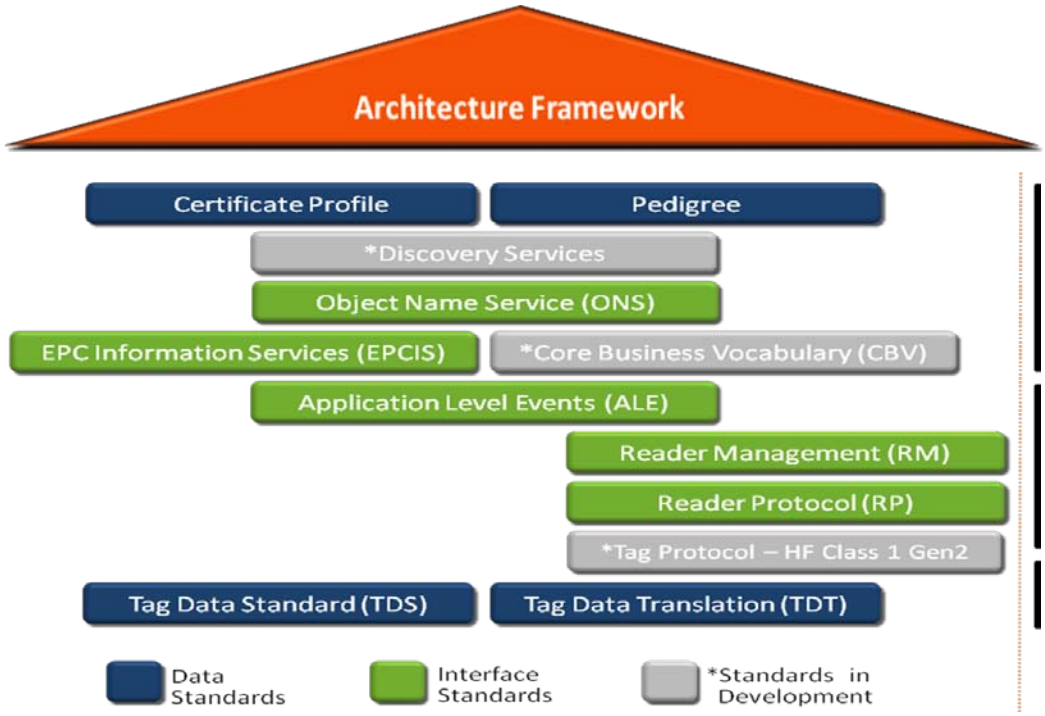
The use cases presented are based on more detailed business operations worksheet descriptions developed by the CE IAG and are available upon request.

7.1. About GS1 EPCglobal Standards

GS1 EPCglobal standards are a set of integrated industry driven standards which have been developed to meet user requirements and are used to:

- Identify individual products, cases, loads, assets, etc, so that they can be tracked individually.
- Capture data about the movement of physical assets, creating visibility.
- Exchange data with IT applications and trading partners, to turn visibility into information and action.

EPCglobal standards are a complement to other GS1 standards (BarCodes, eCom, GDSN).



7.1.1. Class 1 Generation 2 UHF Air Interface Protocol (Gen2) Standard

Commonly known as the "Gen2" standard, this standard defines the physical and logical requirements for a passive-backscatter, Interrogator-Talks-First (ITF), radio frequency identification system operating in the 860 MHz - 960 MHz frequency range. The system comprises Interrogators (also known as Readers), and Tags (also known as Labels).

The UHF Class-1 Generation-2 air interface protocol V1.2.0 extends the item level tagging capabilities of UHF Gen2. In this protocol, 3 optional features have been added. An indicator is now available to show when there is formatted data in user memory. When a tag is read, it will now indicate whether there is something stored in the user memory. As a tag moves through the supply chain, with each addition of information into the user memory an option is available to protect each new block of added information in the user memory from being overwritten or erased. Should a customer take a product back for return or repair, an indicator can be set on the tag to show that the tag has been recommissioned into the supply chain.

7.1.2. EPCglobal Low Level Reader Protocol (LLRP) Standard

The LLRP interface between the Client and the Reader facilitates the management of Reader devices to mitigate Reader-to-Tag and Reader-to-Reader interference and maximize the efficiency of singulation and data operations over the tag population. This is achieved by enabling the Reader device operation at the full performance level of the air protocol. In addition, LLRP provides the interface to transport the results of RF monitoring (also known as RF survey) if the Reader device is capable of performing that function.

7.1.3. Core Business Vocabulary

This document is an EPCglobal normative standard that defines the Core Business Vocabulary (CBV). The goal of this standard is to specify various vocabulary elements and their values for use in

conjunction with the EPCIS standard, which defines mechanisms to exchange information both within and across company boundaries. The vocabulary identifiers and definitions in this standard will ensure that all parties who exchange EPCIS data using the Core Business Vocabulary will have a common understanding of the semantic meaning of that data.

This standard is intended to provide a basic capability that meets the above goal. In particular, this standard is designed to define vocabularies that are core to the EPCIS abstract data model and are applicable to a broad set of business scenarios common to many industries that have a desire or requirement to share data. This standard intends to provide a useful set of values and definitions that can be consistently understood by each party in the supply chain.

Additional user requirements may be addressed by augmenting the vocabulary elements in the document with additional vocabulary elements defined for a particular industry or a set of users or a single user. Additional values for the standard vocabulary types defined in this standard may be included in follow-on versions of this standard.

7.1.4. Object Name Service

The Object Name Service (ONS) is a directory based on the worldwide Internet Domain Name System (DNS). ONS provides a means to look up pointers to authoritative information resources for a Class of Electronic Product Codes (EPC). ONS does not contain actual data about the EPC; it only contains the network address where data resides, for example a Uniform Resource Locator (URL) that refers to an EPC Information Services (EPCIS) operated by the company that commissioned the EPC. The ONS lookup function, being based upon DNS, is implemented by a distributed set of servers. The ONS lookup information would be publicly available for anonymous query. It is perhaps worth explicitly stating that ONS is not intended to hold serialized level object information, it is primary a reference service and will only point to other registries or sources of information. ONS content is mostly static and populated at the time of issuance of the object class identifier.

7.1.5. EPCglobal Discovery, Configuration and Initialization (DCI) Standard

The DCI interface facilitates the management of RFID Readers, Access Controllers and the network on which they operate. The purpose of this document is to specify the necessary and optional operations of a Reader and Client. This allows them to utilize the network to which they are connected to communicate with other devices, exchange configuration information and initialize the operation of each Reader, so that the Reader Operations Protocols can be used to control the operation of the Readers to provide tag and other information to the Client.

7.1.6. EPCglobal Reader Management (RM) Standard

The RM interface standard is used by management software to monitor the operating status and health of EPCglobal compliant Tag Readers. In addition, this document defines the EPCglobal SNMP RFID MIB, and specifies the set of SNMP MIBII groups required to comply with this EPCglobal Reader Management specification over SNMP. The terms “Tag Reader” and “Reader” include RFID tag Readers, supporting any combination of RF protocols, fixed and handheld, etc. It also includes Readers of other kinds of Tags, such as bar codes. Tag Readers, despite the name, may also have the ability to write data into Tag memory.

7.1.7. EPCglobal Application Level Events (ALE) Standard

The ALE standard specifies an interface through which clients may interact with filtered, consolidated EPC data and related data from a variety of sources. The design of this interface recognizes that in most EPC processing systems there is a level of processing that reduces the volume of data that comes directly from EPC data sources, such as RFID readers, into coarser “events” of interest to applications.

It also recognizes that decoupling these applications from the physical layers of infrastructure offers cost and flexibility advantages to technology providers and end users alike. The interface described, and the functionality it implies, is called Application Level Events (ALE).

7.1.8. EPCglobal EPC Information Services (EPCIS) Standard

The goal of EPCIS is to enable disparate applications to leverage Electronic Product Code (EPC) data via EPC-related data sharing, both within and across enterprises. Ultimately, this sharing is aimed at enabling participants in the EPCglobal Network to gain a shared view of the disposition of EPC-bearing objects within a relevant business context.

7.1.9. EPCglobal Tag Data Standard (TDS)

The EPC Tag Data Standard defines the Electronic Product Code, and also specifies the memory contents of Gen 2 RFID Tags. The Tag Data Standard covers two broad areas:

- The specification of the Electronic Product Code, including its representation at various levels of the EPCglobal Architecture and it correspondence to GS1 Keys and other existing codes.
- The specification of data that is carried on Gen2 RFID tags, including the EPC, “user memory” data, control information and tag manufacture information.

7.1.10. Website and Existing standards

The EPCglobal website contains published EPCglobal standards. Go to the following link for more information: www.epcglobalinc.org/standards/ Local GS1 Member Organisations can help you get the necessary knowledge and training on relevant GS1 EPCglobal standards. Your local MO is the primary contact for information on the benefits that GS1 standards can deliver to your business. Full details can be found on: http://www.gs1.org/contact.

7.2. Forward Logistics Use Case

Use Case	Description	EPCglobal EPCglobal Standards Used	How Standards Used	Benefits of Using EPCglobal Standards
Manufacturing Process	▪ Generate SGTIN item level EPC. ▪ Write to item level tag. ▪ Record data to local database. ▪ Write other manufacturing information into tag extended memory as appropriate (test info, etc.). ▪ Record data to local database. ▪ Place product onto pallet and create SSCC EPC pallet tag. ▪ Associate SGTIN EPC item level to SSCC EPC pallet tag and record data to local database. ▪ Write SSCC EPC pallet code to tag and place tag on pallet. ▪ Load pallet onto truck for shipment and confirm SGTIN EPC information with local database. ▪ Dispatch pallet SSCC EPC and all associated SGTN EPCs to transportation vendor.	▪ Tag Data Standard. ▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Generate industry standard unique identification of product through EPC codes. ▪ Write additional process and product information to tag to follow product throughout supply chain. ▪ Use industry standard data sharing method across supply chain.	▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Provides industry standard method of writing and reading information to tag in a secure manner that can be understood by all supply chain partners. ▪ Provides industry standard method of sharing product and process data across supply chain partners.

Manufactured Goods Receiving	▪ Read Pallet SSCC tag and confirm associated SGTIN EPCs. ▪ Unload products into receiving area. Read item level EPC codes and register product receipt into local database. ▪ Read item level EPC codes and associate to put away area in local database.	▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Allows industry standard method of unique identification of product through EPC codes.	▪ Provides an industry standard method of identifying products with partners across supply chain ▪ Offers automated method to identify product and where it should go.
Manufacturing Packing Process	▪ Generate new SGTIN EPC item level code if necessary. ▪ Write new SGTIN EPC code to tag or generate new item level EPC tag if one does not exist. ▪ Write other manufacturing information to extended memory as necessary. ▪ If product reworked, rewrite EPC number to tag if necessary. ▪ Generate SGTIN EPC case tag if necessary ▪ Write SGTIN EPC case code to tag. ▪ Associate SGTIN item level EPC and product serial number to SGTIN case EPC and write to local database. ▪ Place product onto pallet and create SSCC EPC pallet tag. ▪ Associate SGTIN EPC	▪ Tag Data Standard. ▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Generate industry standard unique identification of products through EPC codes. ▪ Write additional process and product information to tag to follow product throughout supply chain process. ▪ Use industry standard data sharing method across supply chain.	▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Provides industry standard method of writing and reading information to tag in a secure manner that can be understood by all supply chain partners.

	item level and SGTIN case EPC to SSCC EPC pallet tag and record data to local database. ▪ Write SSCC EPC pallet code to tag and place tag on pallet. ▪ Load pallet onto truck for shipment and confirm SGTIN EPC information with local database. ▪ Dispatch pallet SSCC EPC and all associated SGTN EPC's to transportation provider.			
Distribution Warehouse Receiving	▪ Read Pallet SSCC tag and confirm associated SGTIN EPC's. ▪ Unload products into receiving area. Read item level EPC codes and register product receipt into local database. ▪ Read item level EPC codes and associate to put away area in local database.	▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Generate industry standard unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain partners.	▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Provides industry standard method of sharing product and process data across supply chain partners.
Distribution Warehouse Rework Pallet	▪ Receive EPCIS data file containing Pallet EPC and item level EPC codes on request. ▪ Read Pallet EPC, Case or Item EPC codes and verify against received EPCIS data file or DESADV message. ▪ Record EPC data into local database per EPCIS standard. ▪ Once rework complete, assemble pallet generating Pallet EPC and associate Case or	▪ EPCIS Standard ▪ Gen2 Standard	▪ Use industry standard data sharing method across supply chain partners. ▪ Generate industry standard unique identification of product through EPC codes.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Provides an industry standard method of identifying products with partners across supply chain.

	Item EPCs ▪ Generate EPCIS file			
Distribution Warehouse Outbound	▪ Receive EPCIS data file containing Pallet EPC and item level EPC codes. ▪ Read Pallet, Case or Item EPC and verify according to database. ▪ Generate EPCIS file for shipment.	▪ EPCIS Standard. ▪ Gen2 Standard.	▪ Use industry standard data sharing method across supply chain partners. ▪ Generate industry standard unique identification of product through EPC codes.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Provides an industry standard method of identifying products with partners across supply chain.
Retailer's DC/TC	▪ Receive EPCIS data file containing Pallet EPC and item level EPC codes to Retailer's DC. ▪ Read Pallet or Case or Item EPC and verify according to database. ▪ Move received product to storage reading item level EPC and registering to local EPCIS database. ▪ Move product to ship to Retailer Shop reading and verifying item level EPC codes. ▪ Generate EPCIS file for shipment.	▪ EPCIS Standards. ▪ Gen2 Standard.	▪ Use industry standard data sharing method across supply chain partners. ▪ Generate industry standard unique identification of product through EPC codes.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Provides an industry standard method of identifying products with partners across supply chain.
Retail Outlet	▪ Receive EPCIS data file containing Pallet and item level EPC codes. ▪ Read item EPC codes and verify according to database when moved from truck to shop storage. ▪ Move received product to storage reading item level EPC and registering to local	▪ EPCIS Standard. ▪ Gen2 Standard.	▪ Use industry standard data sharing method across supply chain partners. ▪ Generate industry standard unique identification of product through EPC codes.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Provides an industry standard method of identifying products with partners across supply chain.

	EPCIS database. ▪ Move product to shop floor reading SGTIN EPC and registering to local EPCIS database. ▪ Register product as sold when customer purchases at the store counter by reading SGTIN EPC and registering to local EPCIS database. ▪ For customer delivery, record SGTIN EPC at customer's home and register to local database.			

7.3. Anti-Counterfeiting Use Case

Use Case	Description	EPCglobal Standards Used	How EPCglobal Standards Used	Benefits of Using EPCglobal Standards
Anti-Counterfeiting	▪ Embed tag in product during manufacturing process. ▪ Sell counterfeit product. ▪ Illegally modify or export product. ▪ Request for illegitimate repair. ▪ Detect the counterfeit product .	▪ Tag Data Standard. ▪ Gen2 Standard.	▪ Generate industry standard unique identification of product.	▪ Provides an industry standard method of detecting counterfeit product. ▪ Manufacturers and service providers can detect counterfeit products through the identification of "illegal tag-IDs". Tag IDs are cross-checked with "authentic EPC enabled tag" tables.

7.4. Repair and Maintenance Use Case

Use Case	Description	EPCglobal Standards Used	How EPCglobal Standards Used	Benefits of Using EPCglobal Standards
Drop-off repair in store and repair at repair centre	▪ Receive product to be repaired at the store. ▪ Carry it to repair centre. ▪ Repair product at repair centre. ▪ Register event to EPCIS. ▪ Return repaired product to customer.	▪ Tag Data Standard. ▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Allows industry standard method of unique identification of product through EPC codes and reading product information. ▪ Write additional process and product information to tag to follow product throughout supply chain process. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of writing and reading information to tag in a secure manner that can be understood by all supply chain partners. ▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Offers automated method to identify product and where it should go.
Repair at customer's home	▪ Repair product at customer's home. ▪ Register event to EPCIS upon return to repair centre.	▪ Tag Data Standard. ▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Allows industry standard method of unique identification of product through EPC codes and reading product information. ▪ Write additional process and product information to tag to follow product throughout supply chain process. ▪ Use industry standard data sharing method across supply chain.	
Pick up product and repair at repair centre	▪ Receive product at repair centre. ▪ Repair product at repair centre. ▪ Register event to EPCIS.	▪ Tag Data Standard ▪ Gen2 Standard ▪ EPCIS Standard	▪ Allows industry standard method of unique identification of product through EPC codes and reading the information. ▪ Write additional process and product information to tag to follow product throughout supply chain process. ▪ Use industry standard	

			data sharing method across supply chain.	

7.5. End Of Life Use Case

Use Case	Description	EPCglobal Used	How EPCglobal Standards Used	Benefits of Using EPCglobal Standards
Disposal Registration (Optional)	▪ Receive disposal request of EOL CE products and register			
Issue new RFID tag (Option during Migration Period)	▪ Generate SGTIN item level EPC. ▪ Write to item level tag. ▪ Associate and register number to SGTIN. ▪ Record to local database and EPCIS. ▪ Send RFID tag to customer to attach to EOL CE products before disposal. ▪ Schedule pick-up of disposed EOL CE products.	▪ Tag Data Standard. ▪ Gen2 Standard. ▪ EPCIS Standard.	▪ Generate industry standard unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Efficient management of Total Product Lifecycle (TPL) of CE goods where tags have not previously been attached (before this step). ▪ Efficient shipping management of EOL CE products.
Pick-up disposed EOL CE products	▪ Read RFID tags attached to disposed EOL CE products from pick-up location and send data to EPCIS. ▪ Deliver the collected EOL CE products to designated collection centre.	▪ Gen2 Standard. ▪ ALE. ▪ EPCIS Standard.	▪ Unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Offers automated method to identify product, location and quantity.
Collection Centre Receiving	▪ Read RFID tag attached to EOL CE products. Register products receipt into local database and EPCIS. ▪ Unload EOL CE products	▪ Gen2 Standard. ▪ ALE. ▪ EPCIS Standard. ▪ ONS Standard.	▪ Unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Offers automated

	into receiving area. ▪ Search for any further information needed in relation to specific products for recycling operation (obtain from manufacturers' information through ONS). ▪ Sort EOL CE products for recycling or disposal. ▪ Store products separately at designated locations and record to local database and EPCIS. ▪ Schedule transportation to recycling/disposal centres.		▪ Unique identification of product through EPC codes. ▪ Search address provided by manufacturers through ONS and access disassembling information.	method to identify product, location and quantity. ▪ Better disassembling by obtaining proper information provided by manufacturers. ▪ Efficient inventory management of EOL CE products.
Collection Centre Shipping	▪ Read RFID tags when recyclable and/or disposable EOL CE products leave the collection centre gate. ▪ Deliver recyclable and/or disposable EOL CE products to appropriate recycling/disposal centre.	▪ Gen2 Standard. ▪ ALE. ▪ EPCIS Standard.	▪ Unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Offers automated method to identify product, location and quantity. ▪ Efficient shipping management of EOL CE products.
Recycling Centre Receiving	▪ Read RFID tags and register products receipt to local database and EPCIS. ▪ Unload recyclable EOL CE products into receiving area. ▪ Sort the recyclable and disposable EOL CE items. ▪ Store them separately at designated inventory locations and record to	▪ Gen2 Standard. ▪ ALE. ▪ EPCIS Standard.	▪ Unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Offers automated method to identify product, location and quantity. ▪ Can use automated sortation systems allowing large quantities of waste to be sorted

	local database and EPCIS.			efficiently. ▪ During automated sortation, can capture and identify brand owner which can be utilized for billing purposes. ▪ Capturing serial numbers will provide associated product category information which can be used by Extended Responsibility Organisations (EROs) to report back to government regarding CE EOL targets. ▪ Efficient inventory management of EOL CE products.
Recycling Process	▪ Read RFID tag and identify any special instructions/cautions for recycling of the CE EOL items. ▪ Disassemble CE EOL items if necessary. ▪ Feed into the recycling operation line (RFID Tags may be deleted/removed and destroyed here). ▪ Collect disassembled un-recyclable parts and/or special hazardous materials and move them to specific locations identified for their storage. ▪ Collect recycled materials at the end of the recycling operation lines. ▪ Load recycled materials into properly identified	▪ ONS Standard ▪ EPCIS Standard. ▪ Gen2 Standard. ▪ ALE. ▪ Tag Data Standard.	▪ Unique identification of product through EPC codes. ▪ Search address provided by manufacturers through ONS and access disassembling information. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Better disassembling by obtaining proper information provided by manufacturers. ▪ Efficient management of TPL of CE products. ▪ Provides an industry standard method of identifying products with partners across supply chain. ▪ Offers automated method to identify product, location and quantity. ▪ Efficient shipping management of EOL CE products.

	containers. ▪ If properly identified containers are not available: 1. Generate GRAI item level EPC 2. Write to item level Tag 3. Attach RFID Tag to new container and associate EPC code to material information. ▪ Record to local database and EPCIS			
Disposal Process	▪ Remove any hazardous materials. ▪ Feed into the disposal operation line (RFID Tags may be deleted/removed and destroyed here).	▪ Gen2 Standard. ▪ ALE. ▪ EPCIS Standard.	▪ Unique identification of product through EPC codes. ▪ Use industry standard data sharing method across supply chain.	▪ Provides industry standard method of sharing product and process data across supply chain partners. ▪ Efficient management of TPL of CE products.

8. Implementation - Getting Started

	Purpose	Knowledge Actions	Business Actions	Analysis Actions	Partners Actions
Investigate	▪ Develop RFID/EPC knowledge.	▪ Learn about EPC/RFID technology.	▪ Understand business drivers (compliance vs. transformation). ▪ Secure Executive sponsorship & funding.	▪ Identify use cases.	▪ Learn about available resources in the EPC/RFID community. ▪ Form a research based RFID project team.
Collect Baseline Data	▪ Provide information for a business case to implement or otherwise. Will provide data for return on investment calculations.	▪ Ability to assign cost to certain processes looking at manpower required, time taken, equipment involved, impact on customer service, etc.	▪ Define and map the current "as is" supply chain processes. ▪ Identify key measurements: Key Performance Indicators (KPI) (e.g. time, frequency, cost, benefit). ▪	▪ These measurements will be used to compare KPI's associated with new RFID processes.	▪ Collect metrics for "as is" processes thus obtaining baseline data.
Experiment	▪ Gain hands-on experience in the lab.	▪ Understand the technology and information flow.	▪ Identify "should be" RFID processes and associated key measurements/KPI s.	▪ Conduct tag placement analysis. ▪ Categorize product/packaging characteristics..	▪ Identify technology partners. ▪ Test various RFID products (e.g. hardware, tags, software).
Trial	▪ Test targeted applications in the field (1-3 locations).	▪ Examine process and environmental related issues in the field.	▪ Document EPC/RFID impacts to business processes. ▪ Define testing success criteria before going into the pilot.	▪ Define EPC system/data architecture, and the EPC numbering scheme. ▪ Obtain GS1 Company Prefixes.	▪ Identify cost drivers. ▪ Form a cross-functional RFID team. ▪ Develop communication plan (at least for internal purposes).

Pilot	▪ Develop a scalable rollout solution.	▪ Verify adoption strategy and cost items, (e.g. products, quantity, how and where to tag).	▪ Decide which EPC reading to be added to the baseline. ▪ Develop a long term plan based on pilot result.	▪ Analyze the in-process data. (e.g. read rates, locations). ▪ Validate performance in end-to-end systematic testing.	▪ Coordinate testing with trading partners. ▪ Select technology partners for pilot and rollout.
Deploy	▪ Engage in phased rollout.	▪ Develop a scoreboard of metrics to adjust implementation parameters.	▪ Measure and track improvement of key measurements/KPI.	▪ Refine business cases for targeted RFID initiatives.	▪ Ongoing collaboration with trading and technology partners on process/data flow improvement.

Source: *GS1 EPCglobal RFID Implementation Cookbook, 2nd Release – Sept. 2006*

9. Where to Get Started in CE Operations

The consumer electronics supply chain consists of complex operations and many aspects should be considered when deciding where to start using EPC/RFID. Given the many players involved in the CE supply chain and operations, a table was used to help the visualization of the advantages and disadvantages of RFID implementation when applied to different operation points with each of the different partners. Note: this table is a high level overview and it does not present all the aspects that can and should be considered nor all of the partners involved.

		Subcomponent	**Product**	**Packed Product**	**Pallet**
		Subcomponents: tagged before the product manufacture work begins.	Item Level Tag: a tag applied at product level in or at the end of the manufacturing process.	Case Level Tag: tag applied at case level.	Pallet Level Tag: tag applied at pallet level.
Manufacturer	Advantages	▪ Better inventory control for manufacturing operations. ▪ Material control.	▪ Unique item identification. ▪ Production statistics. ▪ Firmware control. ▪ Equipment accessories control. ▪ Equipment rework.	▪ Some production statistics. ▪ Lot control.	▪ FIFO (First In First Out) control. ▪ Equipment outbound control.
	Disadvantages	▪ Small items difficult to tag.	▪ Depending on product material tag read can be difficult.	▪ Package is identified and not the product itself.	▪ Level of information may not be enough.
Logistics Provider	Advantages	▪ Not applicable.	▪ Item level logistic control.	▪ Pack level logistic control.	▪ Pallet level logistic control.
	Disadvantages	▪ Not applicable.	▪ May present reading difficulties.	▪ Some tags may present reading difficulties in a pallet.	▪ Only apply while the pallet is assembled.
Retailer	Advantages	▪ Not applicable.	▪ Sales facilities. ▪ Repair. ▪ Recall procedures.	▪ Stock visualization. ▪ Sale control. ▪ Automatic case receiving process	▪ Automatic pallet receiving process.

	Disadvantages	▪ Not applicable.	▪ Consumer privacy concerns.	▪ Product must be stored in original packaging.	▪ Automation in the process only while product stored in pallets.
Final Customer	Advantages	▪ Not applicable.	▪ Facilitates problem identification	▪ No privacy issues	▪ Not applicable.
	Disadvantages	▪ Not applicable.	▪ Privacy issues.	▪ Have to keep the product package in order to preserve identification tag.	▪ Not applicable.
Repair and Maintenance Service Provider	Advantages	▪ Prevention of illegal component replacement.	▪ Repair history management. ▪ Trace of repaired product. ▪ Anti-counterfeit.	▪ Not applicable.	▪ Not applicable.
	Disadvantages	▪ Not applicable.	▪ Privacy issues.	▪ Not applicable.	▪ Not applicable.
End Of Life Operator (Recycler)	Advantages	▪ Indication of unique EOL disassembly procedures or hazardous material identification.	▪ EOL product identification.	▪ Not applicable.	▪ Automatic pallet receiving process. No tag reading problems encountered.
	Disadvantages	▪ Some items are difficult to tag by size and/or material.	▪ Some tags may present reading difficulty.	▪ Not applicable.	▪ The level of information may not be enough.

10. Implementation Challenges

Taking the specific needs of the CE industry total product lifecycle model into account, several implementation challenges arise. The following table lists these challenges and weighs them according to overall priority per supply chain partner. This ranking offers the reader some help in deciding where to get started with item level tagging. The table considers Item Level Tagging (ILT) on both small CE products (e.g. laptop computer, digital camera, mobile phone) and large products (e.g. plasma television screen, refrigerator).

The High Class (Gold) product category only is addressed, which includes:

- Product requires item level traceability for product safety, recycling, maintenance/repair, etc.
- Product needs item level tag either embedded into product or attached directly on product.

10.1. Item Level Tagging Implementation Challenges According to Overall Priority per Supply Chain Partner

Key Table	
Significant Implementation Barrier	
H	High
M	Medium
L	Low

Challenges	**Manufacturer**	**Logistics Provider**	**Retailer**	**Consumer**	**Service Provider**	**EOL Operator**
Tag Cost	H: Return on Investment (ROI) estimation is necessary.			L: Concern for increase in product cost to compensate for high tag cost.		
Tag Size	L: Can be difficult to attach tag to small product.					
Tag Read		H: Bulk reads	H: Bulk reads			

Reliability		may not satisfy read accuracy.	may not satisfy read accuracy.			
Tags vs. Metals	M: Tag is difficult to read due to metal materials.	M: Tag is difficult to read due to metal materials.	M: Tag is difficult to read due to metal materials.		M: Tag is difficult to read due to metal materials.	M: Tag is difficult to read due to metal materials.
Reader Performance	L: Radio wave regulations differ from country to country.	L: Radio wave regulations differ from country to country.	L: Radio wave regulations differ from country to country.		L: Radio wave regulations differ from country to country.	L: Radio wave regulations differ from country to country.
Infrastructure Cost	M: Compatibility with current system is important.	M: Compatibility with current system is important.	H: Clarification of ILT benefits are necessary.			
Security/Privacy	H: Access control to share information through EPCIS is necessary.	H: Access control to share information through EPCIS is necessary.	H: Access control to share information through EPCIS is necessary.	H: Privacy protection without killing tag is necessary.	H: Access control to share information through EPCIS is necessary.	H: Access control to share information through EPCIS is necessary.
Tag Operation	H: Backup of tag data necessary.	H: Method of recovery from backup is necessary.	H: Method of recovery from backup is necessary.			

10.2. Challenges within the Context of the CE Total Product Lifecycle Explained

10.2.1. Tag Cost

Tag cost for the CE industry is not as stringent as other industries. What's important is the ability to estimate the ROI and the benefit that is gained from the use of an RFID system.

10.2.2. Tag Size

In the CE industry, as with all other industries, tag size is of importance for ILT on small product applications. For larger products tag size is not as high a priority.

10.2.3. Tag Read Reliability

There are three major concerns when dealing with tag read reliability within the CE total product lifecycle: the abundance of metal, extreme environmental conditions and the read reliability rate. In the areas of read reliability, tags and readers must deliver a high read rate (almost 100%) so that processes along the supply chain are not held up.

10.2.4. Reader Performance

As mentioned above, high tag read rates are a requirement of the CE industry. In a dense tag environment read performances can be adversely affected by interference caused by the presence of several tags. Readers and associated techniques that can deal with this will boost the successful tag read rate and is a required element of any ILT implementation.

10.2.5. Infrastructure Cost

Infrastructure is another area where minimizing cost is a great concern. Companies have made significant investments in their information systems and the interfaces that run between each. Compatibility with existing systems is very important. Business decisions are driven by the business information contained in the overall system architecture. The introduction of ILT will lead to a more granular level of information and this informed will have to be managed and translated into business intelligence.

10.2.6. Privacy and Security

CE supply chain partners are aware that consumers may have privacy concerns about RFID tags being placed on electronic devices, as opposed to being placed on boxes or cartons that they can throw out.

As ILT is used more and more, issues of security will arise in terms of the information itself and the sharing of information between supply chain partners. Corruption of the data via malicious intent should be considered. As increasing amounts of information is shared across the supply chain, there is concern about the kind of business related information companies can share securely.

10.2.7. Tag Operation

It is possible that a tag could lose its functionality due to physical damage. In such cases, tag operation should be maintained using a substitute. This means that tag data should be duplicated. A

mechanism to back-up information on a tag should be considered. This information can be relied upon when a tag is damaged or when the information on a tag is not accessible.

11. Additional Useful Information

The aim of this document is to provide guidance to global consumer electronics supply chain partners on implementing EPCglobal standards. This is not a technical guideline, however below is some relevant. technical support documentation.

11.1. Approved Test Methods

Available at the following link: www.epcglobalinc.org/test_centers/appr_test_methods/

- Conveyor Portal Test Methodology v1.1.4
- Door Portal Test Methodology v1.0.9
- Field Strength Measurement
- UHF Gen2 Tag Performance Parameters Test Methodology v1.1.3

11.2. EPCglobal Standards Overview

Available at the following link: www.epcglobalinc.org/standards

11.3. RFID Implementation Cookbook

Available at the following link: www.epcglobalinc.org/what/cookbook/

- The EPCglobal RFID Implementation Cookbook is targeted towards readers who already know about RFID and intend to get involved in using the technology. The Cookbook includes information from EPCglobal working groups, many of which are early RFID adopters.
- The objective of the Cookbook is to provide companies with practical and timely information needed as they prepare for RFID pilot and implementation projects by taking advantage of the learning already captured by the EPCglobal member community.
- The Cookbook includes a table of contents with summaries that provide an overview of the information contained in each section. Full details can be accessed through links to additional documents. Many of the documents are accessible by anyone (indicated by the icon);
- Some of the documents are only accessible by EPCglobal subscribers (indicated by the icon). For more information on becoming an EPCglobal subscriber, please contact your local GS1 Member Organisation.
- Cookbook table of contents:
  - Getting Started
  - Tools
  - Measuring Performance
  - Practice Briefings
  - Reference Materials

12. Selecting a Technology and/or Solution Provider

Through global GS1 Member Organisations, GS1 has robust processes in place for the certification of solution providers who provide products and services that support the GS1 system of integrated global standards. GS1 MOs also can provide their extensive knowledge of the compliant technologies. The GS1 global website also contains a wide range of related reference material (www.gs1.org)

MOs can provide assistance in selecting appropriate technologies and/or solution providers that will assist and enable you to successfully implement, such as:

- Checklists to help evaluate products (e.g. software, printers, marking).
- Checklists to help evaluate providers.
- IT System development/installation/migration (from legacy to new).
- Training.

13. Get Involved

Now is the time for your company to get involved in GS1 CE activities. Our current activities cover:

- Master data definition.
- Reverse Logistics processes.
- Visibility of Products and Inventory.
- End of Life processes.
- Integrated Process Optimisation.

Development of specific technical implementation guidelines for the use of EPCglobal standards concerning Filter Values, User Memory and Password management is under discussion.

If you are interested in finding out more about any of these initiatives or would like to get involved in our global activities contact Audrey Kremer at Audrey.Kremer@gs1.org.

14. GS1 Member Organisations

Research, collection of data and a clear understanding of current literature needs to be undertaken to obtain an up-to-date picture of existing standards, solutions, guidelines, procedures and best practices. This will enable organisations to make the right early decisions such as choosing appropriate consulting services and enabling technologies. Local GS1 Member Organisations can help you get the necessary knowledge and training on relevant GS1 EPCglobal standards. Your local MO is the primary contact for information on the benefits that GS1 standards can deliver to your business. Full details can be found on: http://www.gs1.org/contact

15. Abbreviations

BNG	Business Needs Group – IUG sub team that defines a specific set of industry needs
CBV	Core Business Vocabulary
CE TPL	Consumer Electronics Total Product Lifecycle
DNS	Domain Name Service - An infrastructure level Internet service used to discover information about a domain name. Originally developed to map a host name to an IP address, it has since been extended to other uses such as ENUM, which maps a phone number to one or more communication services.
eCom	Electronic Commerce – set of GS1 standards for the electronic exchange of data related to GS1 standards
ECR	Efficient Consumer Response http://www.ecrnet.org/
EDI	Electronic Data Interchange
EOL	End of Life
EPC	Electronic Product Code
EPCIS	Electronic Product Code Information Services
FMCG	Fast Moving Consumer Goods
GDSN	Global Data Synchronisation Network
Gen2	Generation 2 of the EPCglobal Air Interface Protocol Standard for RFID
GS1 EPCglobal CE IAG	GS1 EPCglobal Consumer Electronics Industry Action Group
GS1 MO	GS1 Member Organisation
GSMP	Global Standards Management Process
HRI	Human Readable Interpretation
IEEE	Institute of Electronic and Electromechanical Engineers
IUG	Industry User Group
JIT	Just In Time
LIFO	Last In First Out
MO	GS1 Member Organisation
ONS	Object Name Service - A resolution system, based on DNS (Domain Name Service), for discovering authoritative information about an EPC
POS	Point of Sale
RFID	Radio Frequency IDentification
SBN	Statement of Business Need
SD	System Development

SSCC	Serial Shipping Container Code
TID	Tag IDentifier
UHF	Ultra High Frequency